Bulletin of the

American Ceramic Society

A Monthly Publication Devoted to Proceedings of the Society, Discussions of Plant Problems, Discussions of Technical and Scientific Questions and Promotion of Coöperative Research

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Volume 1, 1922

Edited by the Secretary of the Society, Ross C. Purdy
Assistant Editor, Emily C. Van Schoick

Assisted by Officers of the Industrial Divisions

F. H. Rhead, M. C. Farren — Art

J. C. Hostetter, A. E. Williams — Glass

B. T. Sweely, R. R. Danielson — Enamel

J. S. McDowell, F. A. Harvey — Refractories

F. K. Pence, C. C. Treischel — White Wares

A. F. Hottinger, R. L. Clare — Terra Cotta

C. F. Tefft, M. B. Greenough — Heavy Clay Products

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AUTHOR INDEX TO BULLETIN

The reference number in parentheses refers to the *monthly* number of the *Bulletin;* the number following this is the page number. The letter D preceding reference number indicates that the article is a Discussion (D); the letter O means that article is Original (O).

A list of abbreviations used in the Index is found on page 381, *Ceramic Abstracts.*

Volume 1

SUBJECT INDEX TO BULLETIN

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Vol. 1 May, 1922 No. 1

FRANK H. RIDDLE

President of the American Ceramic Society

Mr. Riddle was elected president of the American Ceramic Society by letter ballot without opposition. For those members who have not had the privilege of meeting him or learning of his record as a ceramist his likeness is here shown and a sketch given.

President Riddle finished his Ceramic Engineering course at Ohio State University in 1907 and since that time has had a broad experience in the manufacture of art pottery, wall tile, porcelain and heavy clay products. He is now consulting engineer and chief ceramist of the Champion Porcelain Company of Detroit and the Jeffery-Dewitt Insulator Company of Kenova, West Virginia.

For two years prior to the war and during the war, Mr. Riddle was a member of the technical staff of the Bureau of Standards. It was he who developed the spark plug used in aeroplanes. The spark plugs made prior to that time would not stand the high temperatures and were a source of disastrous breakdowns. Mr. Albert V. Bleininger, then Director of the Clay Products Division of the Bureau of Standards, assigned Mr. Riddle to this problem and with him made investigations of the compositions and methods of manufacturing that resulted in the spark plug of exceedingly low coefficient of expansion and of very high hot dielectric strength. It was in this study that Mr. Riddle showed best his ability as a ceramic engineer.

FRANK H. RIDDLE

Mr. Riddle has designed, built and managed plants and has installed efficiency methods. His experience as a ceramist and as an executive has been broad. With the support which the ceramic craft has shown willingness to give to an aggressive program of coöperative research and with the leadership of one with so broad and so successful an experience as Mr. Riddle there is every reason for the 1922 record of the Society being the best ever in services rendered to the Ceramic Industries.

WHY IT IS IMPORTANT THAT CORPORATIONS SUPPORT THE AMERICAN CERAMIC SOCIETY

Corporations Have Learned Value of the Society to Them

The American Ceramic Society for these past twenty-three years has been building strong and surely as an organization for the promotion of ceramic researches. When it was first launched it was not possible to interest more than thirty-five manufacturers in its support. They were fearful of disclosing their so-called "manufacturing secrets," and had no appreciation whatsoever of the benefits of coöperation. These thirty-five manufacturers, however, did meet and soon found themselves exchanging bits of information and experiences, and even exchanging written notes concerning formulae, equipment and methods. They became so enthusiastic over the benefits of thus meeting together once a year and of having their discussions printed in "Annual Transactions," that they invited others to join with them. Today there are over 1600 joined in this coöperative enterprise, each gaining from the reported experiences of others.

Low Personal Subscription

Through all of these years, the Board of Trustees of the Society has been determined to keep the personal subscription at a very low figure. The personal subscription is now $7.50. The Board of Trustees has felt, and does now feel, that it is very essential that the personal subscription shall be kept low, so that the young men in the factories and the young men just leaving college and entering into the industry may enjoy the full privileges of the Society without undue tax on their incomes.

Monetary Value to Corporations

The monetary values of benefits accruing from activities of the American Ceramic Society are much larger and more direct to the corporations than they are to the persons. No corporation would hesitate to pay $25.00 for a bit of information which it thought would be a benefit in either reducing cost or improving product. Many corporations are paying out many times this amount for very much less than they are obtaining from the publications of, and from personal contact in, the American

Ceramic Society. When it is considered that the American Ceramic Society really is an organized research personnel, producing information based on actual laboratory determination and plant application, giving reports of proven facts of value to the manufacturer, the corporations should have no hesitancy in supporting the larger activities in which the Society is now engaged by subscribing to a corporation membership, dues, of which are $25.00 a year.

Larger Activities of the Society

These larger activities consist altogether in the more thorough organization of the Industrial Divisions and the activities of the Standing Committees, directing their efforts to definite ends, not only in researches themselves, but also in application of the result of researches. In the early days, and more so of late, the publications of the Society have perforce of circumstances been confined more to reports of researches in the fundamentals or scientific and have had to forego the development of personal discussions on the floor of the Conventions and in their publications. The Society has not had the funds to develop the application of the results of these fundamental studies in ceramic science nor given opportunity of exchange of opinion and experiences through discussions.

Estimated Budget

It is estimated that the Society can enter into, to a very full extent, all of these activities, on a budget not exceeding $40,000 per year. $15,000 of this $40,000 will be realized from the advertising in the *Journal* and *Bulletin*, and the larger part of the remaining $25,000 must be obtained from membership dues. The Society has never made an assessment and it will be the policy of the Board of Trustees that an assessment shall not be levied. It would be defeating the purposes of the Society to raise the personal dues, and therefore it is but natural that the corporations will be asked to pay the small subscription of $25.00 a year in support of this organized promotion of research. They have received, and will continue to receive, the largest monetary benefit, and therefore should be providing for the larger part of the funds that are necessary to sustain the activities of the Society.

This is a statement of facts, not a plaintive appeal.

The Board of Trustees has no fear but that corporations will see the benefits of a virile organization devoted exclusively to the promotion of technical and scientific things in ceramics. They already realize the importance of this in trade matters and they have shown their appreciation of the necessity for organized technical research.

PERSONAL VERSUS CORPORATION MEMBERS IN THE AMERICAN CERAMIC SOCIETY

The paying of personal dues by corporations has developed the question of personal *versus* corporation dues, because the purpose of each of these classifications is not clear with the members. We have had corporations resign as such when their representatives learned that they could have the rights and benefits of membership for $7.50 a year. Therefore, they argue, why pay $25.00? Other corporations have told their men that their personal subscriptions were to be cancelled since the firm had subscribed as a corporation member. In all but very few such instances we have succeeded in so stating the importance of both personal and corporation memberships that the Society has not been the loser.

We are not questioning the policy of corporations paying personal memberships of employees. In some instances there is advantage in this to all concerned, and certainly no disadvantage to the Society.

Value of Personal Memberships

The Society an Educational Institution.—To the individual, the Society is an educational institution, an opportunity to increase knowledge, acquaintance and outlook, not alone in a particular industry, but in all of the ceramic industries. An investigator or plant operator cannot afford to be without the literature, the forum, the opportunities of co-operation, the broadening knowledge of problems and of their solution in all ceramic lines.

The Society Broadens Intellectual Opportunities of Members.—To be without the opportunities of membership in the American Ceramic Society would be limiting one's sphere of knowledge and acquaintance and certainly one's opportunities. The most successful members of university faculties refuse industrial connections because they value the opportunity to engage in research and to publish their results without restrictions. Technical societies give this same sort of opportunity to men in the industry of "letting their light so shine before men that their good work shall be known."

The Employee's Value to Employer Increased by Activities of the Society.—A person is given an industrial position and a salary because of what, and in proportion to what, he knows and can do. Keeping abreast of the times is just as important a factor in one's value to a firm as preparation before entering industry. Indeed, he becomes of less and less value to a concern unless he not only keeps abreast with new discoveries, etc., but also makes his contribution to the new knowledge of materials, processes, equipment, and especially of the application to industry of scientific fundamentals.

Technical societies give opportunities for a person to receive from many

co-workers in return for that which he contributes. Thus his knowledge and facilities are manifolded. It is foolish to think that these manifolded returns come in any such proportions to those who attend conventions only for what they can learn, as to those who do things and give to others of their knowledge and experience.

Summing up the advantages of membership to individuals, it can be said in truth that the Society is necessary to the individual if he is to continue his present value or is to increase his value to the concern which gives him employment. A person in the ceramic industry cannot afford to be without a personal membership in the Society.

Value of Corporation Membership

The Value of Research Is Recognized.—The returns from the activities of the Society to corporations are almost directly financial. The importance and value of research to industries is well known. The millions given in support of researches by individuals, and corporations, not alone in industrial but also in public and semi-public laboratories speak with far more force than words concerning the importance of research to manufacturers. The inestimable value to industries of researches done and published by the Federal Bureaus, the Geophysical Laboratory and the several industrial laboratories is well known. There is no longer a reason for anyone to doubt the value of research. The National Research Council is a magnificent monument to the belief of successful manufacturers in the necessity of research in industry.

The Value in Personal Contact and Discussions.—That the results of these researches may be applied with greatest profit to the industries, it is essential that the technical men and the plant operators get together to discuss these results from the view-point of conditions in the individual plants. There is value accruing to the corporations when their technical men and their plant operators get together to tell of experiences in plant application of the results of researches.

The Importance of Researches Made in Plants.—A great deal of research work is done right in the plants; research that cannot be carried through in laboratories. Such researches are essential to the productiveness of the laboratories. It is just as important for the laboratory investigators to keep posted on the researches made in the factories, as it is for the factory investigators to keep posted on the researches made in the laboratories. This means direct returns to the manufacturers.

It is only in technical societies that the laboratory and the factory investigators can get together to discuss, analyze and make plans for further work.

The Value in Corporations Exchanging Research Information.—The technical societies give opportunity for each concern to receive from

all the other contributing concerns in exchange for the information they give. This is a manifolding of returns on investments made in research that should make it plain to every manufacturing concern that it pays to give financial support to technical societies. It is especially vital that the ceramic manufacturers give support to this, the only Society devoted exclusively to the promotion of Ceramic Arts and Sciences.

The Value of the Society to Corporations Is Direct.—The returns enjoyed by corporations from the activities of the American Ceramic Society are directly financial, and these returns will be in proportion to the support given.

If the total annual subscription of a corporation was $100 it would be an inadequate measure of the value which the Society has been and can be to each corporation. It matters not how many personal subscriptions a firm pays for its employees it will not be giving support to the Society in proportion to the direct returns enjoyed. The returns to corporations will be in proportion to the number of individuals who make contact with the activities of the Society, hence it behooves a concern to make these contacts through as many of their personnel as is possible, but it is also to their interest to give financial support to the Society that these personal contacts of their employees may be the more productive.

The corporation annual fee of $25.00 is small in comparison with the usual fees, yet it is adequate to meet the budget of the Society, when each of the ceramic corporations will be doing its share.

Fellow Member!—Is your firm making your membership of more value to it through an annual corporation subscription? Does this suggest a duty you owe to yourself, to your firm, and the Society?

AMERICAN CERAMIC SOCIETY EXCURSION TO ENGLAND AND EUROPE

A year ago members of the Society received a communication from Mr. C. O. Grafton inquiring who would be interested in being one of the party to visit England in 1922 in response to the invitation of the British Society of Glass Technology. Several hundred replies to that inquiry were received and in consequence, negotiations with the English Society were commenced with regard to the reception of those of our Society who are interested in things other than Glass. Dr. Turner writes that the Refractories group surely will be welcome. Definite assurance regarding the other groups has not been received but the negotiations are still in progress and the indications are favorable in the case of the White Ware group, and there have been no definitely unfavorable reports.

Accordingly reservations have been made on the Cunard Line Aquitania sailing from New York on August 22, 1922, for the accommoda-

tion of about 40 persons. The rate is $275.00 plus tax ($5.00) per passenger, from New York to Southampton. Furthermore the Cunard Line has given assurance that every effort will be made to insure a comfortable and enjoyable trip. A small group of about ten have already "signed up," but unless a party of at least twenty-five is secured the reservations must be cancelled and the trip postponed. These reservations must be taken up or cancelled before June 29th and so decisions must be made not later than June 1st. Of course an early reply will be necessary from those intending to make the trip. In such a case, deck plans of the Aquitania will be sent so that cabins may be selected. Dr. Turner has in charge the arranging of the tour of England, which will require about three weeks. Special trips will be arranged for the several groups representing the Divisions of our Society. Those wishing to visit the continent will be expected to make their own arrangements since no organized visit will be made. Dr. Endell has assured us of a welcome in Germany and Dr. Turner will assist in arranging tours to the Continent.

The steamship agency in Pittsburgh through which these reservations have been made has offered numerous courtesies regarding the securing of passports, the insurance of baggage and the securing of hotel accommodations in New York for the party for the day or two before sailing. The details of these arrangements will be communicated later to those who are planning to join the party.

Those interested will please notify Dr. E. Ward Tillotson of Mellon Institute, Pittsburgh, Pa., as early as possible.

THE NEED FOR ORGANIZATION IN SCIENTIFIC RESEARCH[1]

By Elihu Root

Chairman of the Board of Trustees, Carnegie Institution of Washington

Extracted from Vol. 1, Part 1, No. 1, Oct., 1919, *Bulletin of the National Research Council.*

I have no justification for expressing views about scientific and industrial research except the sympathetic interest of an observer for many years at rather close range. One looking on comes to realize two things. One is the conquest of practical life by science: there seems to be no department of human activity in which the rule of thumb man has not come to realize that science which he formerly despised is useful beyond the scope of his own individual experience. The other is that science, like charity, should begin at home, and has done so very imperfectly.

Science has been arranging, classifying, methodizing, simplifying everything except itself. It has made possible the tremendous modern development of the power of organization which has so multiplied the effective power of human effort as to make the differences from the past

[1] Washington, D. C., August, 1918.

seem to be of kind rather than of degree. It has organized itself very imperfectly. Scientific men are only recently realizing that the principles which apply to success on a large scale in transportation and manufacture and general staff work apply to them; that the difference between a mob and an army does not depend upon occupation or purpose but upon human nature; that the effective power of a great number of scientific men may be increased by organization just as the effective power of a great number of laborers may be increased by military discipline.

This attitude follows naturally from the demand of true scientific work for individual concentration and isolation. The sequence, however, is not necessary or laudable. Your isolated and concentrated scientist must know what has gone before, or he will waste his life in doing what has already been done, or in repeating past failures. He must know something about what his contemporaries are trying to do, or he will waste his life in duplicating effort. The history of science is so vast and contemporary effort is so active that if he undertakes to acquire this knowledge by himself alone his life is largely wasted in doing that; his initiative and creative power are gone before he is ready to use them. Occasionally a man appears who has the instinct to reject the negligible. A very great mind goes directly to the decisive fact, the determining symptom, and can afford not to burden itself with a great mass of unimportant facts; but there are few such minds even among those capable of real scientific work. All other minds need to be guided away from the useless and toward the useful. That can be done only by the application of scientific method to science itself through the purely scientific process of organizing effort.

This relation of the scientific worker to scientific work as a whole can be furnished only by organization. All the world realizes now the immense value of the German system of research applied at Charlottenburg and Grosslichterfelde. That realization is plainly giving a tremendous impetus to movements for effective organization of scientific power both in England and in the United States—countries whose whole developments have rested upon individual enterprises. It remains to be seen whether peoples thoroughly imbued with the ideas and accustomed to the traditions of separate private initiative are capable of organizing scientific research for practical ends as effectively as an autocratic government giving direction to a docile and submissive people. I have no doubt about it myself, and I think the process has been well begun in England under the Advisory Council of the Committee of the Privy Council for Scientific and Industrial Research, and in the United States under the National Research Council.

I venture to say two things about it. One is that the work cannot be done by men who make it an incident to other occupations. It can be encouraged of course by men who are doing other things, but the real

work of *organization* of research must be done by men who make it the whole business of their lives. It cannot be successful if parcelled out among a lot of universities and colleges to be done by teachers however eminent and students however zealous in their leisure hours. The other thing is that while the solution of specific industrial problems and the attainment of specific industrial objects will be of immense value, the whole system will dry up and fail unless research in pure science be included within its scope. That is the source and the chief source of the vision which incidentally solves practical problems.

AMERICAN CERAMIC SOCIETY EXHIBITION

The First American Ceramic Society Ceramic Display

By Frederick H. Rhead

For the first time in the history of the American Ceramic Society, an exhibition of the various ceramic products was held during the twenty-fourth annual convention. While there was little time in which to plan this exhibit, the response from manufacturers, educational institutions, and studio potters was very satisfactory, and every Division was represented.

The display was not only well attended, but the members were much interested in the exhibits, as was evidenced by the many interesting discussions relating to the various types of ceramic wares shown. The following classification will give a fair idea of the scope of the activities represented.

Art Division

Schools

The New York State School of Clayworking, under Profs. Marion L. Fosdick and Clara K. Nelson; Prof. C. F. Binns, Director. Included in the group executed by the students of this school were some very charming, and well-finished turquoise vases and bowls.

The Department of Ceramics of Iowa State College, Ames, Iowa, under the direction of Paul C. Cox. This exhibit was particularly interesting because it gave a good idea of the scope of work covered by this school. It is very evident that there is a serious attempt to develop the resources of the state. Different types of clay were used. In this exhibit were examples of art wares, stoneware utilitarian vessels, casseroles, etc., buttons made of red clay, an incense burner, and a small enameled metal bowl.

The Newcomb School of Art, Mary G. Sheerer, Instructor, sent a most dainty group of bowls, tea caddies, and vases made with a light-colored clay and glazed with soft green, and other colored enamels. These pieces were very nicely finished and gave ample evidence of great care, and considerable skill.

The Lewis Institute, Chicago, Illinois, under the direction of W. W. Wilkins, had a group of hand built pottery finished in matte and enamel

FIG. 1.—View of Art Exhibit. Rookwood Pottery in large case at left. Fulper Pottery in far corner. Vases by Prof. C. F. Binns at right. Overbeck Pottery on table in center.

FIG. 2.—Art Exhibit. Newcomb College and Lewis Institute Pottery on center table. S. A. Weller Pottery, left corner. Paul Revere Pottery, right corner.

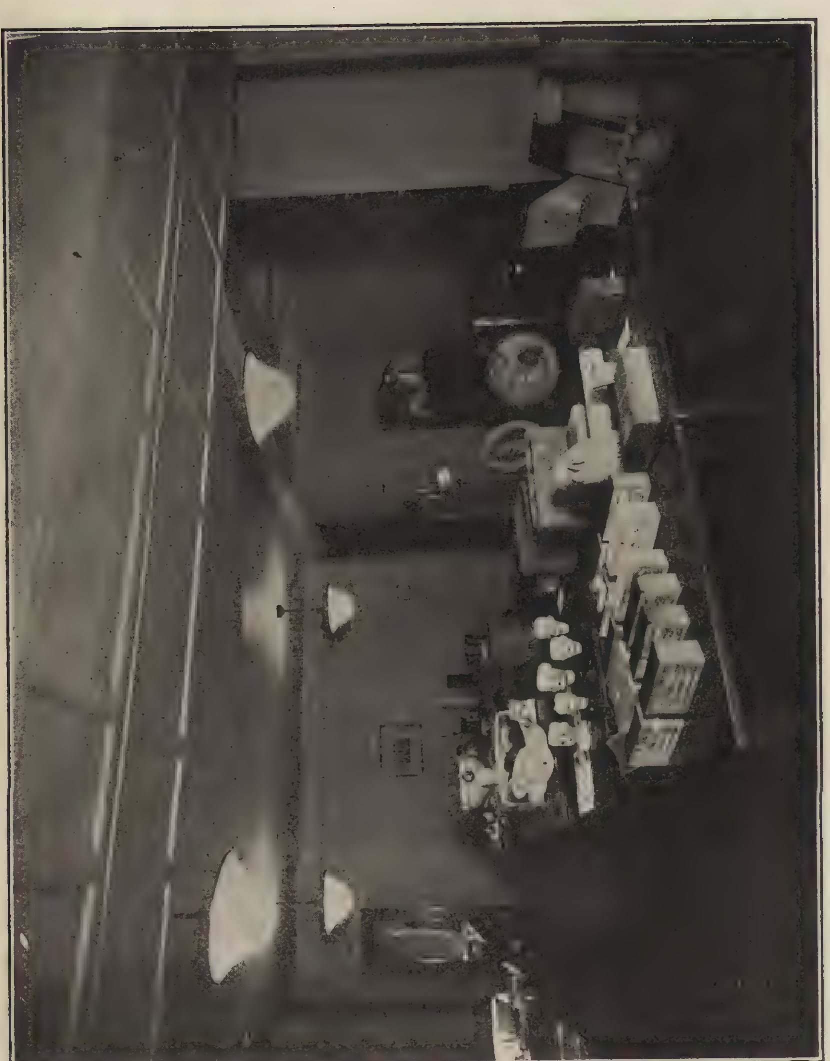

FIG. 3.—Refractories and Terra Cotta Exhibit.

FIG. 4.—White Ware Exhibit.

glazes, and also a series of glaze experiments. In connection with the latter, it is hoped that other schools will follow this example and exhibit experimental work.

The St. Louis Grade Schools sent a small group of hand built vases and flower holders.

Miss Mabel C. Farren, formerly instructor in pottery in the Carnegie Institute of Technology, Pittsburgh, exhibited a series of photographs of pottery made by the students under her direction.

Art Potteries

The Rookwood Pottery exhibited a beautiful group of vases showing various developments during the later years of their activity. In this group were examples of their famous "Tiger Eye" glaze, their exquisitely executed slip decorations, and a very handsome rose jar of Chinese type.

Fulper Pottery was represented by a group of vases in stoneware, or Gres, finished in mirror black, matte and enamel glazes.

Newcomb College, New Orleans, sent a group of vases and bowls finished in nicely balanced harmonies of greens and blues. Newcomb Pottery, with its well-designed woodland decorations, is one of the few distinctive American Potteries.

Other potteries exhibiting were The Paul Revere Pottery, Boston, Mass., showing examples of their well-known nursery utilitarian ware, and S. A. Weller of Zanesville, Ohio, who sent a wide range of ornamental pottery, including lustres, matte glazes, enamels, modeled birds, etc.

Studio and Individual Potters

The most noticeable impression received by the follower of the Arts and Crafts movement when viewing such a ceramic exhibition as the one under discussion is of realization that the American potter is surely and definitely becoming master of his craft.

Both in the schools and in the small studio potteries, the technique and execution has developed to a standard far ahead of that of the studio clayworker of ten, or even five years ago. In fact, the craft has already advanced to a stage where it is possible to name from a dozen to twenty schools and individual potters who can show the products of their kilns side by side with the work of European potters of high reputation without suffering in comparison.

The credit for this development naturally belongs to the schools; and, because these schools are giving due attention to such important factors as workmanship, execution, technique, or all those conditions that contribute to what is good in potting, the various manufacturers, and others who are actively interested in the higher development of the industry, can not do better than to use every available means to encourage and support the schools in the work they are doing.

List of exhibits of individual potters: Professor C. F. Binns, Director of the New York State School of Clayworking, had a case of very beautiful stoneware vases and bowls. One piece, a gourd or bottle-shaped vase, is fine enough to find a place in any museum among a collection of American contemporary art.

Arthur E. Baggs, Marblehead, Mass., had two most attractive and skilfully executed jardinières. Russell G. Crook, South Lincoln, Mass., sent two stoneware vases with cleverly designed animal motifs. Mrs. Frederick H. Rhead sent a series of porcelain panels with Pate-sur-pate figure decorations; the Misses Overbeck, Cambridge City, Indiana, exhibited a variety of shapes very prettily decorated and executed. Miss Mabel C. Farren, Pittsburgh, Pa., sent a series of earthenware and porcelain dinner plates decorated with liquid underglaze colors. Bertha Riblet Pire, Cleveland, Ohio, sent some very attractive tile. Mr. B. S. Radcliff and Mr. L. A. Behrendt, St. Louis, had a pair of chrome-tin pink enamels, and Mrs. Mary Chase Stratton of the Pewabic Pottery, Detroit, sent a group of tile and vases finished in enamels and lustre, all most charming in color and texture.

A case of cabinet pieces, showing examples of Sung, K' ang-shi, Chenlung, and also some Japanese porcelains of the old school, from the collection of F. H. Rhead were used for reference purposes during various process discussions.

Glass Division

The Glass Division was represented by H. C. Fry Company, of Rochester, N. Y., with examples of cut glass, baking wares and some very attractive utilitarian articles.

White Ware Division

This Division was represented by the Knowles, Taylor and Knowles Co., East Liverpool, Ohio, Hercules China Co., Sebring Pottery Co., Sebring, Ohio, Homer Laughlin China Co., Newell, W. Va., Edwin Knowles Co., East Liverpool, Ohio. The Universal Sanitary Manufacturing Company of Newcastle, Pa., sent three examples of their cast sanitary ware. One of these pieces was in cross section showing the even thickness all through the piece when made by the cast process. The Coors Porcelain Co., of Golden, Colorado, had a comprehensive exhibit of chemical porcelain. The General Electric Company, Schenectady, N. Y., The Lapp Insulator Co., LeRoy, N. Y., and the Jeffery-DeWitt Insulator Company, Kenova, W. Va., exhibited examples of various types of porcelain insulators.

A series of plates showing various ceramic colors was shown by the Roessler-Hasslacher Company, New York. The examples of porcelain doll heads made by the Fulper Pottery Company, Flemington, N. J., should also be included in the white ware group.

Terra Cotta Division

FAIENCE AND TERRA COTTA WARES

The following concerns sent examples of architectural faience and terra cotta: The Northwestern Terra Cotta Company, Chicago, Ill.; O. W. Ketcham Terra Cotta Company, Crum Lynn, Pa.; American Terra Cotta Company, Chicago, Ill.; St. Louis Terra Cotta Company, St. Louis, Mo.; The Conkling Armstrong Company, Philadelphia, Pa.; The Rookwood Pottery Company, Cincinnati, Ohio; and The Flint Faience Tile Company, Flint, Mich.

Conrad Dressler sent a series of photographs of bas-relief panels, a bust in terra cotta of Philip Dressler, and a very beautiful sketch medallion finished in blue and green transparent glazes.

Refractories

The Refractory Division was represented by The Norton Company, Worcester, Mass.; The Carborundum Company, Perth Amboy, New Jersey; The Mitchell Clay Manufacturing Company, St. Louis, Mo.; and the Laclede-Christy Clay Products Company, St. Louis, Mo.

Stoneware

The Maurice Knight Company of Akron, Ohio, sent a number of examples of acid-proof chemical stoneware.

PROPHETIC COST ACCOUNTING

By G. W. Greenwood

The ultimate aim of the American Ceramic Society is to increase human happiness. With building materials of clay, man possesses a more beautiful and a more comfortable home; by pottery and other objects of ceramic art it is furnished and made more attractive; a brick road leads to it; by tile, his land is drained, and refractories play their part in the production of everything in the manufacture of which fire has been employed.

This Society affords each member an opportunity of understanding better the part performed by others in this pursuit of the common welfare, and, by their sympathetic coöperation, its members help one another.

The importance of this harmonizing and illuminating influence, as here exhibited, becomes more fully realized when one sees the indifference, even the antipathy, of men engaged in different phases of the same, or kindred, subjects, as in pure and applied science, research and practical operation.

Too often practical men, without whose services we would starve, are not in sympathy with research, without which we would have no progress. For instance, a practical man might ask the use of the chemistry of the

stars, yet helium, named for the place of its discovery, was first found on the sun, thus outdoing Baron Munchausen whose hatchet, altho found on the moon, had been previously lost on the earth. That the propagation of yellow fever is through the bill of a mosquito of a certain species, which a certain number of days before has bitten another victim, is a discovery which justifies all the time spent in studying the habits of insects. When Pasteur first contemplated the study of spontaneous generation, his friends attempted to dissuade him from wasting his time on that barren subject, and yet modern surgery is but one of the results. Kepler studied astronomy, giving the world the three laws which bear his name, laying the foundations upon which Sir Isaac Newton builded, but he practiced astrology on the side to pay expenses. The Curies, when they started out to track radium to its lair, little suspected, as we indeed little suspect now, the future possible applications of this element. Research is like the leaden casket which promises nothing but which pays the best.

On the other hand, however, men intent upon scientific pursuits too often care naught for the possible benefits therefrom: Gauss, the mathematician, thanked God for the theory of numbers, because it was a branch of mathematics which could not possibly be put to any practical use.

But while pure and applied investigators find here in this Society a meeting place, a common forum, there is yet one science for which neither faction has much, if any, respect. And that is Cost Accounting.

Practical men see in it no promise of profit, and the research investigator sees in it no promise of hidden truth. Both are sadly mistaken. The accountant is viewed as one who merely juggles figures, making different combinations, but unable to alter their total. For instance, the writer has been asked, "What difference does it make anyway? Whatever system is used, you have no more money in the bank."

And of ordinary, post mortem cost accounting, this may indeed be true, for instead of dealing with live problems, the accountant too often spends most of one month embalming and wrapping in red tape results which expired the last day of the previous month.

This is what I mean by post mortem accounting: About the twentieth of the month, the bookkeeper presents the management with a statement of the operating and other expenses for the previous month, each element being divided by the output (or by some other factor).

Instead of entering into a critical discussion of this process, since this is not a meeting of accountants, consider the following illustration: Suppose one were to take daily readings for a month of the temperature of all kilns under fire, add these temperatures, and divide by the total number of readings, presenting this average to the manager about the twentieth of the following month. Of what use would this average be in controlling current kiln temperatures? Or, suppose on going to the ticket agent for infor-

mation concerning trains to St. Louis, with a view to attending a meeting of the American Ceramic Society, the agent were to tell you that, instead of advance information as to the movement of trains, he had on file only the result of the movement of trains during the previous month: and that this result was found by taking the time of all trains between Pittsburgh and St. Louis, freight and passenger, express and local, and dividing the total time by the number of trains which started from Pittsburgh during the month. Of what use would this information be to you?

I can see no difference between these hypothetical cases and the actual case of a manager wishing to know the cost of certain fire clay shapes which he proposes to make the following week, but who is offered instead the result of taking the charges for the previous month and dividing by the nine-inch equivalent of all brick and shapes, hand made and machine, standard and special, easy and difficult, which were molded.

We are told, authoritatively, that considerably less than ten per cent of the country's industries have a cost system. But if we define cost finding as *the elimination of waste and the reduction of costs by means of modern accounting methods*, then the number having cost systems will shrink to an alarming extent.

The principles underlying scientific accounting are the same as those for any other science and they are already recognized, and employed, by this Society. Therefore this Society can give a decided impetus to actual, constructive cost accounting.

The first element in a successful system of accounting is *predetermination*. But here again, let us draw our illustrations from familiar sources. To the ancients, there existed seven heavenly bodies: the Sun, the Moon, Mercury, Venus, Mars, Jupiter, Saturn, a complete, a perfect number, known to man as far back as written records extend. That there might be another planet was beyond the scope of one's imagination. Then, by chance, using his home-made telescope, Herschel discovered a new planet which was named Uranus. Years later a mathematician sent an astronomer word to turn his telescope to a certain part of the heavens and to look for a new planet. And thus was Neptune found by calculation before it was seen. How? By the fact that the movement of Uranus was predicated, but that it did not conform to the path worked out for it.

The discovery of the telescope was soon followed by the discovery of four moons of Jupiter. Their eclipses were observed, and future eclipses predicted. But future eclipses failed to occur on schedule time. At one time they would be punctual, several months later they would be behind hand, then again they would conform to the forecast. From this discrepancy came the discovery of the velocity of light, which up to that time had been thought to be instantaneous. From this also is derived a relationship between light and electricity, and from it the Einstein theory has been

evolved. From a study of the properties of chemical elements, the existence of new, and as yet undiscovered, elements was successfully predicated and the properties foretold.

These illustrations could be multiplied. But the lesson they all teach is this: If one merely recorded the past, and did not forecast the future, what progress would there be? Aside from that which comes by accident, most progress results from prediction followed either by verification confirming our hypotheses to this extent, or by discrepancies which lead to investigation and new discoveries.

It is the business of science to *predict*. It is the business of a scientific cost system to *predict costs*, and then either to confirm the prediction or to investigate the discrepancies. *A cost system, to be profitable, must be prophetic.*

To you, of course, this presentation is not new. Prophecy is ingrained in your methods of operation. It is only the cost department which lives in the past. I trust that upon your return to your labors, you will say something like this to your accounting departments: "We lay out in advance, a running schedule. We plan to make a product of a specified size, shape, or color; to stand up under a certain fusion test, or under a specified rattler test. We plot before it is fired the curve to which the temperature of a kiln should conform. We make promises of future delivery of material. We have a definite time to start the day's work, and a standard turn per day. We know what each machine is supposed to turn out per hour. We have an hourly wage, and an established salary list. Everything possible is predicted, and performances are checked up against predictions. *We expect you to take this same course in your accounting.*"

ACTIVITIES OF THE SOCIETY

Annual Tables of Constants and Numerical Data

PHYSICAL, CHEMICAL AND TECHNOLOGICAL

The confederation of French scientific societies has renewed for the year 1922 its contribution of 40,000 francs in support of Annual Tables. The total subscription in France to this project during the year 1921 was 80,000 francs.

At the approaching meeting of the International Union of Pure and Applied Chemistry which is to be held at Lyons in June, the matter of organizing the work of Annual Tables upon a solid financial basis will come up for consideration. This important international project has had a very precarious existence since 1914 and the fact that the work has been continued at all has been due to the efforts of the General Secretary, Dr. Charles Marie.

Plans for providing a certain and sufficient budget for the work during the next five years are in preparation, based upon definite annual contributions from the various countries in the International Union.

It is announced that the National Research Council of Japan has appointed the following Advisory Committee for Annual Tables:

Yasuhiko Asahina	(Tokyo)	Seiji Nakamura	(Tokyo)
Eiji Aoyagi	(Kyoto)	Kyoji Suyehiro	(Tokyo)
Kotaro Honda	(Tohoku)	Umetaro Suzuki	(Tokyo)
Katsuji Inouye	(Tohoku)	Takuro Tamaru	(Tokyo)
Gen-itsu Kita	(Kyoto)	Mitsumaru Tsujimoto	(Tokyo)
Koichi Matsubara	(Tokyo)	Nobuji Yamaga	(Tokyo)
Tsuruzo Matsumura	(Kyoto)	Noboru Yamaguti	(Tokyo)

The Chairman of the Committee is Professor Yukichi Osaka, Japanese member of the International Commission in charge of Annual Tables.

The American Ceramic Society contributes to the support of this great coöperative enterprise.

Report of Annual Meeting of White Wares Division

It affords me great pleasure to inform you that the annual meeting of the White Wares Division was a great success, both from the standpoint of attendance and from the number and character of papers contributed.

At the business meeting, the by-laws recommended by the Rules Committee for use in the several divisions were adopted in their entirety.

The following officers were elected for the year 1922:

Chairman—Samuel B. Larkin,
National China Co., Salineville, Ohio.

Secretary—C. C. Treischel,
General Electric Co., Schenectady, N. Y.

Chairman Research Committee—F. K. Pence,
Knowles, Taylor & Knowles, East Liverpool, O.

Chairman Rules Committee—August Staudt,
Perth Amboy Tile Works, Perth Amboy, N. J.

Chairman Membership Committee—Ira E. Sproat,
Mahoning Clay Company, Sebring, O.

Chairman Nominating Committee—Mr. Herbert E. Goodwin,
Crescent China Co., Niles, O.

Chairman Standards Committee—H. Spurrier,
Square D Company, Peru, Ind.

The White Wares Division representative on the Coördinating Service Council will be as follows:

Committee on Research—F. K. Pence.

Committee on Standards:

(*a*) Standardization of Tests, F. S. Hunt.

(*b*) Standardization of Products, H. Spurrier.

Committee on Data—C. C. Treischel.

Out of a total of 22 listed papers and colloquiums, 18 were presented at the Divisional meeting.

The Division, by a unanimous vote, adopted a resolution to carry a coöperative investigation of the sagger problem, as affecting the White Wares Industry. This problem will, no doubt, be taken care of within the near future by the Research Committee.

Chester Treischel, *Secretary*,
White Wares Division

Minutes of the Fourth Annual Meeting of the Glass Division of the American Ceramic Society

Hotel Statler, St. Louis, Mo., Feb. 28, 1922.

The meeting was called to order by Vice-President J. C. Hostetter, J. H. Forsyth acting as Secretary. The following papers were read:

The Passing of King Methane, S. R. Scholes (read by W. A. Yung).

Reports on Tentative Standards of Glass House Refractories and on Lime, A. Silverman (read by D. W. Ross).

A Note on the Effect on Manganese in Glass of Melting at Reduced Pressure, E. N. Bunting.

Operation of Leers, C. E. Frazier.

After adjournment for lunch the reading of papers was continued.

A Small Glass Tank, H. T. Bellamy.

The Handling, Storing and Setting of Glass Pots, Wm. M. Clark and J. H. Forsyth.

Physical Defects in Tank Blocks, G. A. Loomis.

Disintegrating Action of Water on Soda Lime Glass, A. E. Williams.

Evolution and Development of Glass House Equipment, J. S. Herzog.

The meeting was again called to order on Wednesday, March 1st at nine-thirty A.M.

This session commenced with a discussion of tentative specifications for Glass House Refractories. It was voted that "The Report of this Committee as such, be not accepted as tentative specifications for refractories and that it be referred back to the Committee on Standards and that said committee consult with a committee appointed from the Refractories Division and the two committees consult with committee C-8 of A. S. T. M."

After discussing the "Tentative Specifications for Lime in Glassmaking" it was voted *to adopt the specifications as tentative.*

The colloquium topics were then taken up and resulted in a lively and interesting discussion. Indeed the entire meeting was characterized by free and lively discussions.

The following officers were elected for the ensuing year.

Chairman	J. C. Hostetter
Vice-Chairman	A. R. Payne
Secretary	A. E. Williams
Councillors	H. W. Hess
	J. W. Wright

It was voted that the Chairman be given instructions and power to appoint all committees.

E. WARD TILLOTSON, *Secretary*

NEW MEMBERS RECEIVED SINCE FEBRUARY 20, 1922

ASSOCIATE

Abbott, Harold W., St. Marys, Pa., Carbon Division, Stackpole Carbon Co.

Adams, C. C., Latrobe, Pa., Sec.-Treas., Conemaugh Iron Works Co.

Adams, Samuel P., 29 S. LaSalle St., Chicago, Ill., Ashland Fire Brick Co.

Adderley, James R., 50 Lower Potter St., Brierley Hill, S. Staffs., England, Chemist, E. J. & J. Pearson Ltd.

Aichele, Albert E., 524 Orchard Ave., Cambridge, Ohio.

Anderle, Emil J., 132 E. Hudson Ave., Dayton, Ohio, International Clay Machinery Co.

Beebe, Daniel S., Chamber of Commerce Bldg., Chicago, Ill., Vice-Pres., Treas. and Gen. Mgr., The Vitrolite Co.

Birner, William, Box 139, R. R. No. 1, East San Gabriel, Cal., Washington Iron Works.

Bittner, A. G., Central Sta., Box 1400, St. Louis, Mo., Factory Supt., National Enameling and Stamping Co.
Black, Percy C., Amherst, Nova Scotia, Pres., Nova Scotia Clay Works Ltd.
Breese, A. G. C., 344 N. Pearl St., Bridgeton, N. J., Furnace Foreman, Illinois Glass Co.
Burt, P. E., Box 1026, Huntington, W. Va., Saks Stamping Co.
Busch, Albert D., 5379 Pershing Ave., St. Louis, Mo., The W. S. Tyler Co.
Bussell, William T., Brazil, Ind., Plant Supt., The Clay Products Co.
Butterfield, Fred H., 4906 McPherson Ave., St. Louis, Mo., Plant Mgr., Crunden Martin Mfg. Co.
Caven, Trevor M., 26 Cortlandt St., New York City, Consulting Engineer, Quigley Furnace Specialties Co.
Conard, John B., 91 W. Third Ave., Mansfield, Ohio, Supt., Richland Shale and Brick Co.
Condit, Leo B., 23 N. Lotus Ave., Chicago, Ill.
Cossette, Louis J., 1821 Vernon St., N. W., Washington, D. C., U. S. Bureau of Standards
Craig, Robert H., 15607 Loomis Ave., Harvey, Ill., George M. Clark & Co.
Dandurand, Raymond A., Brazil, Ind., Sec., The Clay Products Co.
Dedouch, J. A., 611 S. Elmwood Ave., Oak Park, Ill., Mgr., Imperishable Miniatures Co.
Duty, S. M., 4900 Euclid Ave., Cleveland, Ohio, Pres. and Treas., The Medal Paving Brick Co.
Elsenius, Charles A., 1631 Woolsey St., Berkeley, Cal.
Ford, Karl L., 3555 Eleventh St., N. W., Washington, D. C., U. S. Bureau of Standards
Frank, G. Harry, 3328 Monroe St., Chicago, Ill., The Meyercord Co.
Geuder, George, 38 Fifteenth St., Milwaukee, Wis.
Hazelwood, Fred, 310 R St., N. E., Washington, D. C.
Heinz, George P., 1740 Champa St., Denver, Colo., The Heinz Roofing Tile Co.
Herzog, John S., Newark, Ohio, Gen. Mgr., The Simpson Foundry and Engineering Co.
Holbert, John S., 7349 N. Paulina St., Chicago, Ill., Dist. Mgr., Hardinge Co.
Hollowell, R. D. T., 110 S. Dearborn St., Chicago, Ill., Sec., American Face Brick Association.
Holman, Harry B., 1017 Olive St., St. Louis, Mo., Mgr., Industrial Division, Commercial Dept., Laclede Gas Light Co.
Ivery, Sidney H., 4432 Gibson Ave., St. Louis, Mo., Enamel Plant Supt., Hydraulic Press Brick Co.
Jeffery, L. Edson, Detroit, Mich., Champion Porcelain Co.
Johnson, Joseph, Trenton, N. J., Chemist, Research Division, Trenton Potteries Co.
Jones, John E., 28 Vine St., Trenton, N. J., Trenton Potteries Co.
Jones, Walter A., 50 Third St., Columbus, Ohio, Pres., W. R. Jones & Co.
Kahn, Bertrand B., Hamilton, Ohio, Sec. and Gen. Works Mgr., Estate Stove Co.
Kneisel, Carl F., Box 732, Sheridan, Wyo., Sec.-Treas. and Mgr., Sheridan Press Brick and Tile Co.
Lasley, Marshall, 801 Volunteer Bldg., Chattanooga, Tenn., Vice-Pres., Southern Clay Mfg. Co.
Lawrence, George J., 7709 S. Morgan St., Chicago, Ill., The J. B. Ford Co.
Leyerle, Arthur R., 3595 W. 47th St., Cleveland, Ohio, Vitreous Enameling Co.
Lindsay, R. D., W. 16th Ave. and Clay St., Denver, Colo., Supt., The Denver Pressed Brick Co.
Lippert, Walter T., 1322 Broadway, Alton, Ill., Illinois Glass Co.
Llige y Pages, Juan, 304 Consejo de Ciento St., Barcelona, Spain
Lockwood, L. J., 106 Hampton St., Bridgeton, N. J., Illinois Glass Co.
McGean, Ralph L., 545 Hanna Bldg., Cleveland, Ohio, Harshaw, Fuller & Goodwin Co.
Mahoney, Frank B., Chattanooga, Tenn., Asst. Supt., Crane Enamel Ware Co.

Marsh, Charles M., Illinois Glass Co., Bridgeton, N. J., Gen. Supt., Cumberland Plants
Meissner, Max, 201 Chestnut St., Hoopeston, Ill., Sprague Canning Machine Co.
Millar, James B., Box 248, Poteau, Okla., Treas., Athletic Mining and Smelting Co.
Mills, Harry R., 255 N. Hoyne Ave., Chicago, Ill., L. W. Wolff Mfg. Co.
Moellering, Walter S., 414 Montgomery St., Fort Wayne, Ind., Mgr. of Sales Promotion, William Moellering's Sons.
Morris, Bert W., 5049 Murdock Ave., St. Louis, Mo., Supt., Parker Russell Mining and Mfg. Co.
Nelson, L. C., Peru, Kansas, Mgr., Mid-Continent Clay Co.
Nickerson, F. P., 8100 Broadway, Cleveland, Ohio, Engineer, The W. S. Tyler Co.
Niegsch, Paul H., Scranton, Pa., Scranton Enameling Co.
Oberlin, John F., 1021 Society for Savings, Cleveland, Ohio
Redrow, Walter L., 3533 Thirteenth St., N. W., Washington, D. C., U. S. Patent Office
Reed, Robt. R., Rockefeller Hall, Ithaca, N. Y.
Renkert, Oliver W., Canton, Ohio, Vice-Pres. and Gen. Mgr., Metropolitan Paving Brick Co.
Riddell, Wallace C., 1429 LeRoy Ave., Berkeley, Cal., Chemical Engineer
Roth, H. A., 463 East 28th St., Brooklyn, N. Y., Lalance & Grosjean Mfg. Co.
Schreiber, George L., Box 265, Santa Monica, Cal.
Seelig, Albert F., 2193 Railway Exchange Bldg., St. Louis, Mo., Industrial Furnace Engineer
Sharkey, Samuel M., Trenton, N. J., Asst. Supt., B. O. T. Mfg. Co.
Sheffield, Albert H., 1701 Prairie Ave., Chicago, Ill., American Terra Cotta & Ceramic Co.
Skinner, Ramsey, 4471 Olive St., St. Louis, Mo., Treas., Reeves & Skinner Machinery Co.
Stover, J. Homer, 176 Grant Ave., Nutley, N. J., Sales Mgr., John Johnson Co.
Stratton, Mrs. W. B., 10125 Jefferson, E., Detroit, Mich., Pewabic Pottery
Sulliva, Willard P., 110 West Plume St., Norfolk, Va., Nansemond Brick Corp.
Thomas, James R., Crawfordsville, Ind., Standard Brick Co.
Varney, William P., 133 West Washington St., Chicago, Ill., Hydraulic Press Brick Co.
Vincent, Lawrence A., 1740 East 12th St., Cleveland, Ohio, American Dressler Tunnel Kilns, Inc.
Wachovec, Peter, 2463 E. 84th St., Cleveland, Ohio, Vitreous Enameling Co.
Waggoner, Chauncey W., 730 University Terrace, Morgantown, W. Va., Professor of Physics, University of West Virginia
Widemann, R. V., 32 rue de la Grange aux Belles, Paris, France
Wikoff, Alan G., 1570 Old Colony Bldg., Chicago, Ill., Industrial Editor, *Chemical and Metallurgical Engineering*
Wilkes, Gordon B., Massachusetts Institute of Technology, Cambridge, Mass., Asst. Professor of Industrial Physics
Zur Horst, Herbert H., 1463 Greenmont Ave., Dormont, Pa., Ceramist, Vitro Mfg. Co.

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American Trona Corporation, 233 Broadway, New York City
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Electric Porcelain and Manufacturing Company, Trenton, N. J.
Eureka Flint and Spar Company, Trenton, N. J.
Hazel-Atlas Glass Company, Wheeling, W. Va.
Huntington Tumbler Company, Huntington, W. Va.
Millville Bottle Works, Millville, N. J.
Pass & Seymour, Inc., Solvay, N. Y.

Schaffer Engineering and Equipment Company, 2828 Smallman St., Pittsburgh, Pa.
Standard Sanitary Mfg. Co., Tiffin Works, Tiffin, Ohio

Play Ball

Ninety-nine new members between February 20 and March 30! This averages 25% more than the record for December, January and the first part of February. The reason for this gain is that forty-five members have been at bat, and ten of these have been up more than once. A. B. Christopher has a wicked wallop with four hits to his credit; C. H. Modes, Geo. W. Shoemaker, and D. F. Stevens each pounded the pill three times; while Ed. Brockman, L. J. Frost, James Hamilton, R. D. Landrum, F. H. Riddle and E. W. Washburn each put it over twice. Those in the one-hit column are as follows: H. C. Arnold, Davis Brown, G. H. Brown, W. F. Brown, Horace H. Clark, R. R. Danielson, W. E. Dornbach, Philip Dressler, O. V. Earl, W. J. Frey, Donald H. Fuller, Wm. D. Gates, S. Geijsbeek, M. B. Greenough, Chester H. Jones, J. T. Keenan, I. A. Krusen, R. H. McElroy, P. S. MacMichael, H. J. Mauschbaugh, G. F. Metz, Edward Orton, Jr., Wiley T. Rabun, B. S. Radcliffe, H. Ries, H. H. Sortwell, Stockton Fire Brick Company, C. W. Thomas, Leo Thürlimann, Karl Türk, S. F. Walton, Wm. W. Wilkins. Corporation Members were secured by G. C. Kalbfleisch, F. G. Lord, and Karl Türk. Members obtained through the Secretary's office, which are not included above, bring the total to eighty-one Associate and ten Corporation memberships.

This is the kind of work that counts. If forty-five *more* members will enter into the game this month, there ought to be another increase of 25%. Do you want to send a sample copy of the *Journal*, or material descriptive of the Society, to a "Prospect?" Let the office of the Secretary help you.

Your Dues are Paid

If they were not, you would not have received this number of the *Journal.* If the other fellow in your department has not received his copy, ask him if his dues are paid. He may be one of the three hundred members who have not paid for 1922. This means that he will not receive the April and subsequent numbers of the *Journal* until he pays up. We do not like to cut his name off the mailing list but postal regulations demand it. The missing numbers will be supplied when he "comes across," but it will not be much fun for him to get nine numbers of the *Journal* all at once next December. Tell him to take the price of two seats at a Shakespearian play, which he would not go to anyway, and send it to us now. Everybody has $7.50 the first week in the month.

WHO'S WHERE IN THE AMERICAN CERAMIC SOCIETY

Gail Truman has gone to Glendale, Cal., where he will be associated with **F. B. Ortman** at the Tropico Potteries, Inc. **B. S. Radcliffe,** formerly of Des Plaines, Ill., takes Mr. Truman's place at the St. Louis Terra Cotta Co.

Leon J. Frost, lately connected with the Phillips & Clark Stove Co., Geneva, N. Y., has returned to Cleveland, Ohio, to be with the Vitreous Enameling Co., of which **R. D. Landrum** is now vice-president.

George A. Loomis, lately with the Bureau of Standards, is with the Ohio Valley Clay Co., at Steubenville, Ohio.

L. H. Hart, after some time as manager of the Construction Department of the National Lime Association, has established "Building Lime Service" at Buffalo, N. Y.

E. F. Theobald has recently taken a position with the Metropolitan Paving Brick Co., at Canton, Ohio.

J. A. Nagle was in the office of the General Secretary recently, having taken up his residence in Columbus, as representative of the Pittsburgh China Co.

F. K. Pence, President of the American Ceramic Society during 1921, has been with Knowles, Taylor & Knowles, of East Liverpool, since January first.

NECROLOGY

Merritt Brooke Cheney was born in Mechanicsburg, Ohio, June 30, 1886, and died at Grant Hospital, Columbus, Ohio, on December 24, 1921, after an illness of eleven days. Mr. Cheney was graduated from Ohio State University in the Department of Ceramics in 1909. For seven years he engaged in consulting ceramic engineering work, the last four years of this time at Inglewood, Ontario, where he built and operated a plant successfully until the war necessitated shutting down and Mr. Cheney returned to the States. He was commissioned as First Lieutenant in the Chemical War Service and worked at Cleveland and Zanesville on charcoal for gas masks. His discharge from the army did not come until April, 1919, when he, with Capt. Barneby, formed the Barneby-Cheney Engineering Company, at Columbus. Plans were being made for a new plant at the time of Mr. Cheney's death. He is survived by his wife and three sons, to whom the sympathy of his friends in the American Ceramic Society is extended.

Thomas L. Strong, born in Frankfort County, Kansas, April 27, 1866, died at his home in Coshocton, Ohio, September 5, 1921. He began his business career in early life, being associated with the Novelty Stamping Company of Bellaire, Ohio, and a little later with the Enterprise Stamping & Enameling Company, of the same city. In 1903 he organized The Strong Enameling Company, which was later changed to Strong-Batelle Mfg. Co., and 1909 the name was again changed to The Strong Mfg. Co. In 1912 a new plant was built at Sebring, O. Owing to ill health he retired from business in the spring of 1919 and located at Coshocton, O.

A few months later, seeming to have recovered from his breakdown, he became interested in the Lafayette Stamping & Enameling Company of West Lafayette, Ohio. There was a recurrence of his trouble, and he was obliged to retire from business again.

He was a man of strong Christian character; a hard and consistent worker and a close student of business and economic conditions; sharing with his employees the profits of his business. His sterling character and congenial good nature won for him the love and esteem of all who knew him.

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BULLETIN
of the
American Ceramic Society

A Monthly Publication Devoted to Proceedings of the Society, Discussions of Plant Problems, Discussions of Technical and Scientific Questions and Promotion of Co-operative Research

Edited by the Secretary of the Society Assisted by Officers of the Industrial Divisions

F. H. Rhead, M. C. Farren — Art
B. T. Sweely, R. R. Danielson — Enamel
J. C. Hostetter, A. E. Williams — Glass
J. S. McDowell, F. A. Harvey — Refractories
F. K. Pence, C. C. Treischel — White Wares
A. F. Hottinger, R. L. Clare — Terra Cotta
C. F. Tefft, M. B. Greenough — Heavy Clay Products

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Onondaga Pottery Co., Syracuse, N. Y.

Vol. 1 June, 1922 No. 2

EDITORIALS

THE BULLETIN, A FORUM OF MUTUAL HELP

Workers and foremen at the leer, the press, the kiln, in the dryroom, or the decorating shop know a great deal. They can express it in the language of the shop and this is the language that directs the making of the output. They must be encouraged to talk, made to feel that what they know is important, given aid if needs be in writing out their observations. They must learn that "Ceramics" is not high-brow stuff, however much we have to concentrate on the chemistry and physics of it. Nobody ever made ware from mixtures of feldspar, kaolin, fluorspar, etc., that are expressible in exact chemical formulae. The empirical formulae which we use are abstractions and we know it. They are chemical and physical modifications; a means of codifying results; a systematic means of analyzing the empirical observations made in the shop. But we can not analyze intelligently, if we do not have record of observations from the many shops.

The *Journal* is recording observations from many laboratories, but substantial progress can be made much more rapidly and with much less expenditure of time and material if the factory operators will in like manner make record of their observations. The operator is naturally abashed by the ability of expression of the theoretically trained man. Some operators are confused by the idiom in which these trained men write. Too often they try to hide it by pretending to understand, and then creep into

their shells. And often they have a chance to see, in the pitiless logic of results, that college training has not always made for either judgment or straight reasoning.

If all are to profit most, the hand of equal fellowship must be extended. The *Bulletin* is the medium for doing this. It is to be hoped that many of our technical men will present in these columns concrete applications of the results of research to concrete problems of plant operation. The operators must profit by these, hence the language must be their language, which does not mean, of course, a perversion of English, but freedom from the abstractions and condensations they do not use or understand. The spirit should not be that of instruction, but the giving of information to draw out information in return.

Should not this platform of information and interchange of practical and scientific observation be of mutual advantage?

KARL LANGENBECK

THE AMERICAN CERAMIC SOCIETY AND THE POTTERY INDUSTRY

More than ever there is need at the present time of a clearing house for the collection and distribution of technical information pertaining to the pottery industries. Without underestimating in the slightest degree the ability the American manufacturers have shown in advancing and extending their business it is a fact that at no time has it been so essential that the knowledge of raw materials and the study of processes be brought to a new level of accuracy and reliability. It is only in this way that competition, both foreign and domestic, can be met adequately.

It is necessary in the first place that we learn to differentiate the various raw materials now on the market and new ones as they may appear, and to purchase them on the basis of specifications which are fair and equitable and which have a legal status. Such specifications would be a protection both for the buyer and seller and would eliminate the uncertainty which often exists as to the qualities really desired. Again, there are many questions relating to factory operations and the fundamental principles involved upon which further light is necessary, in order that the burden of responsibility and uncertainty under which the master potters labor may be lightened. We need only cite a few of the difficulties which constantly appear such as crazing, dunting, blistering and splitting out. We need more information concerning the best sagger mixtures and their most thorough preparation. Again, we certainly must work toward a solution of the firing problem. What improvements can be made in existing kilns and what type of kiln is to be adopted in the future? In brief, there is distinct need of solving these general problems by co-operative effort.

In doing so collectively we need not interfere with individual effort or encroach upon the work of plants who conduct investigative work of their own, since some of the questions confronting us are too large to be solved by any single firm, no matter how strong its position may be.

It is in this work that the Amerian Ceramic Society may be of great value. The Society therefore invites the co-operation of the manufacturing potters. It is the one agency best equipped to do such work and to render service of a kind which will help place our pottery industries in the lead. It is to be hoped that all who are engaged in the pottery industry or connected with it will identify themselves with the Society and take an active part in the work of the division dealing with white wares

ALBERT V. BLEININGER

THE ART DIVISION

Its Activities and Its Possibilities

This is one of the seven Divisions of the American Ceramic Society for the promotion of Ceramic Arts and Science. The Division recognizes that Ceramic Technology and Science must go hand in hand with craftmanship if there is to be the fullest development of the Ceramic Art profession.

The artist who attains the largest success has a working knowledge of the materials with which ceramic wares are fashioned and decorated. Modeling, sculpture, design and coloring; the use of pastes, glazes and stains to produce commercial ware that is distinctive and pleasing to the eye; these are the tasks of the artist. The production of ceramic bodies, glazes, pastes and stains suitable for ware that shall be both serviceable and artistic is the task of the ceramist. It is self-evident that a working knowledge of the media with which the artist works and of the methods employed in fabrication of ceramic wares is necessary before an artist can create ceramic art pieces.

The "Lost Art in Potting" is a divorcement of the creative ability of the artist and the knowledge of the ceramist. To him who has available both the knowledge to compound and the ability to fashion and decorate, there is no such thing as the "Lost Art in Potting."

It is significant that the highest quality wares are made in those countries where the young potter not only serves apprenticeship in a pottery but also has opportunity to attend art schools in which he learns the art of fashioning and the science of compounding.

The Art Division of the American Ceramic Society was organized in recognition of the industrial need for co-ordinating Ceramic Art and Ceramic Science. This Division will succeed in this only to the extent to which the artists co-operate. This is an opportunity for the artists to join with

the ceramic technologist in making possible a distinctive American Ceramic art in American studios, clubs, schools and industry.

Program of Activities

1. Activities in the Interest of the Novice Ceramic Artist.—American artists of School and Club are interested chiefly in faience and majolica tile and pottery. To them the decorative possibilities of the different types of enamels, mat, crystalline and colored glazes, and the possibilities of each type at different heat treatments are for the most part unknown. Knowledge of under-glaze pastes, their composition, preparation, and use is not generally possessed by these novitiate artists.

The Art Division of the American Ceramic Society will give the opportunity for those who join in support of the Society by membership subscriptions to collaborate with the ceramic technologists in furnishing information regarding:

(*a*) Clays, body mixtures, methods, glazes, colors, firing, etc.
(*b*) Courses of instruction.
(*c*) Equipment.
(*d*) Sketches of shapes and designs.

2. Activities in the Interest of the Industrial Artist.—The many methods employed in decorating ceramic ware will be described and illustrated and advice given on suitability of each to particular types.

3. Activities in the Interest of Ceramic Art and Technical Schools.—The stress that is given abroad to the importance of private and Government schools for the teaching of Ceramic Art and Science is evidence that worth-while returns have been enjoyed.

The promotion of industrial schools, in collaboration with the White Wares Division, for the teaching of ceramic technology and ceramic technique will be one of the activities of the Art Division.

The Value of Membership in the American Ceramic Society to Ceramic Artists

1. This is the only national organization that gives opportunity for the ceramic artist to collaborate with the ceramic technologist.

2. Opportunity will be given to obtain information on ceramic mixtures for all sorts of decorative purposes.

3. Opportunity for discussion and exchange of experience will be found in the *Bulletin*.

4. Information regarding equipment and supplies for studios will be given when requested.

5. Description of methods of preparing the materials for and the shaping of wares will be made, including drawings, etc.

6. The Art Division will in fact be a "collective bargaining" for the advisory services of the best ceramic technicians and artists.

7. Compilation of "up to the minute" information on all sorts of items of value to ceramic artists will be published and sold to members of the Society at a large reduction. At the present time members receive a forty per cent reduction on all publications of the Society.

8. The extent to which the program of activities here outlined can be carried through is in direct proportion to the support given by the ceramic artists. Can any ceramic artist afford to refuse his share in making this possible?

9. The Society has served the ceramic interests well and with increasing success for twenty-four years. It is not a new or novel enterprise and has thoroughly proved its capacity and ability.

OUR BUDGET FOR 1922

On page 124 of the Abstract Section of the April issue of the *Journal* is the budget for the calendar year 1922. Summarized, the figures are as follows:

Income		Expense	
Membership Subscriptions	$19,000.00	Publications	$18,575.00
Advertising	17,700.00	Commission	4,185.00
Other Incomes	3,180.00	Executive	12,620.00
	$39,880.00	Divisions and Committees	4,500.00
			$39,880.00

These figures set the goal to be attained this year in facilities for service. If the Society is to give the service which the Board of Trustees decided should be the minimum during 1922 it will be necessary to realize a net increase of 300 Associate Members at $7.50 and 150 Corporation Members at $25.00 per annum; and it will be necessary to sell about $2000 more advertising.

Object of the Society.—Certainly the prime objective of the Society is not the publication of a journal. If issuance of a journal were the chief objective, the Society is proceeding in a very unbusinesslike fashion. The *Journal* is essential to the fundamental purposes of the Society but it is in no wise a commercial proposition.

The *Journal* is a record of researches made, and a medium for promoting organized research. It is the most important of the working tools of the Society.

The service rendered by the contributors, the abstractors, and the associate editors is of inestimable value. The "goods delivered" by the Society are in the *Journal*. It is a record of the things accomplished not only by our own members but by all investigators the world over. The

Journal, however, never has been and never will be the motivating and activating reason for ceramic craftsmen, executives and technologists giving support to the Society. More subscribers to the work of the Society are desired that the Society may the more efficiently and effectively promote the Ceramic Arts and Sciences by laboratory investigations and plant application and not simply to support the publication of a journal. The requirements of these industrial times are more exact information of all sorts, a more thorough knowledge of how to effect economies and of how to meet the market specifications as to quality. The obtaining and the applying of such knowledge is the prime purpose of the Society. Such service when rendered will bring cash profit to the employee for thereby his value to his employer is increased. Such service will bring cash profit to the corporations that make plant application of the things thus discovered and proved.

The budget figures show what is needed by the Society if it is to meet its obligations in the big scheme of co-operative research demanded by present industrial conditions, and if it is to be of the value to its subscribing members which they have a right to expect.

The Society needs more effective working tools if it is to serve the ceramic crafts in the fashion and to the extent demanded of it. The production of the sort of information and the publication of it in the sort of journal which these times require costs real money.

This is the why and the wherefore of the goal of 300 more personal members at $7.50, 150 more corporation members at $25.00 per annum, and increased advertising.

ACTIVITIES OF THE SOCIETY

Facts about the Summer Excursion to England and Europe

Date of sailing	August 22, 1922
Steamer	Aquitania, Cunard Line
Cost of passage, one person one way	$280.00
Latest date for taking up reservations	June 29, 1922
Person to be notified	Dr. E. W. Tillotson, Mellon Institute, Pittsburgh, Pa.
Duration of visit in England	About three weeks
Special arrangements made for visits to plants	Glass, White Wares, Refractories

Trips to the continent to be arranged individually with the assistance of Dr. Turner and Dr. Endell.

A special and urgent invitation has just been received from Vereinigte Grossalmerode Thonwerke, Grossalmerode, Germany, for us to visit them under the guidance of Dr. Endell.

The actual railroad travel will amount to about $40 and the hotel expenses will depend upon the class of hotels selected. One can certainly plan on $1000 to $1200 as a minimum for the entire trip.

Summer Meeting August 14–19, Inclusive

Toronto, Hamilton, Montreal, Kingston and Quebec

The committee arranging for the summer meeting consists of

Millard F. Gibson, *Chairman,* The Interlocking Tile Co., Toronto.
N. B. Davis, O'Brien and Fowler, Ottawa.
L. H. Cole, Department of Mines, Ottawa.
Howells Frechette, Department of Mines, Ottawa.
G. Percy Cole, Dominion Glass Co., Montreal.
H. F. Dingledine, National Fire Proofing Co., Hamilton.
R. F. Segsworth, Feldspars Ltd., Toronto.
Everett Townsend, Frontenac Floor & Wall Tile Co., Kingston.
Randal K. Robertson, Cooksville Shale Brick Co., Cooksville, Ont.

The itinerary of ceramic plants and mines to be visited has not been worked out. Sufficient is it to tell at this time that no more pleasant week's jaunt could be planned. It will give opportunity to renew friendships and to spend restful hours on lake steamers. Modern plants of all sorts as well as feldspar mines will be visited. The route will probably take us down the Niagara Gorge from Niagara Falls to Lewistown, across Lake Ontario to Toronto, along the full length of the Lake, through the Thousand Islands, shooting the rapids in the St. Lawrence River and landing at that historic city, Montreal.

Details of cost and schedule will be announced as early as possible but this much is certain: no one can plan a more delightful summer excursion than that which the committee is arranging for the week of August 14.

Annual Convention of the Society

February 12 to 17, inclusive, Pittsburgh, Pa., is the time and place of the 1923 Annual Convention of the American Ceramic Society.

This will be the 25th anniversary, the Silver Jubilee celebration. It was in Pittsburgh that Elmer Gorton and Sam Geijsbeek made the proposal to Professor Orton that a Ceramic Society be organized, and it was in Pittsburgh that Professor Orton called together the first group of ceramists at that time and laid plans which developed into the incorporation of the American Ceramic Society.

The charter members are planning to make the first day of this convention a big occasion in the interest of Ceramic Science and Technology. The men who are doing big things for Ceramics will be with us on that day.

Calendar of Conventions

Electrical Manufacturers Club—Hot Springs, Va., second week of May, 1922, Fred L. Bishop, Sec., Hartford Faience Co., Hartford, Conn.

National Association of Purchasing Agents—Rochester, N. Y., May 15–20, 1922, H. R. Heydon, Sec., 19 Park Place, New York City

National Coal Association—May 17, 1922, W. B. Reed, Sec., 200 Commercial Bank Bldg., Washington, D. C.

American Society of Refrigerating Engineers—Detroit, Mich., May 24–26, 1922, W. H. Ross, Sec., 154 Nassau St., New York City

American Boiler Manufacturers Association—Stockbridge, Mass., May 29–31, 1922, H. N. Covell, Sec., 191 Dyckman St., Brooklyn, N. Y.

Ceramic Society (England)—trip to Sweden and Denmark, May 27–June 10, 1922, J. W. Mellor, Sec., Stoke-on-Trent, England

Tile Manufacturers Credit Association—June, 1922, F. W. Walker, Sec., 1 Reeves Bldg., Beaver Falls, Pa.

American Association of Engineers—Salt Lake City, Utah, June 4–6, 1922.

Electric Power Club—Hot Springs, Va., June 5–7, 1922, S. N. Clarkson, Exec. Sec., 1017 Olive St., St. Louis, Mo.

American Foundrymen's Association—Rochester, N. Y., June 5–9, 1922, C. E. Hoyt, Sec., Marquette Bldg., Chicago, Ill.

American Institute of Chemical Engineers—Niagara Falls, Ont., June 19–22, 1922, J. C. Olsen, Sec., Polytechnic Institute, Brooklyn, N. Y.

American Construction Council—Washington D. C., June 19–20, 1922; Organization Meeting

American Association for the Advancement of Science—Salt Lake City, Utah, June 22–24, 1922

American Society for Testing Materials—Atlantic City, N. J., June 26–July 1, 1922, C. L. Warwick, Sec., 1315 Spruce St., Philadelphia, Pa.

International Union of Pure and Applied Chemistry—Lyons, France, June 27–30, 1922.

National Bottle Manufacturers Association—July, 1922, C. R. Stevenson, Bus. Mgr., 120 Broadway, New York City

Annual Safety Congress of the National Safety Council—Detroit, Mich., August 28–September 1, 1922

American Chemical Society—Pittsburgh, Pa., Sept. 5–9, 1922, Charles L. Parsons, Sec., Washington, D. C.

Association of Iron and Steel Electrical Engineers—Cleveland, Ohio, September 11–15, 1922, John F. Kelly, Sec., Empire Bldg., Pittsburgh, Pa.

Eighth National Exposition of Chemical Industries—New York City, September 11–16, 1922

American Electrochemical Society—Montreal, Canada, September 21–23, 1922

National Association of Commercial Organization Secretaries—Chicago, Ill., October 23–25, 1922, John E. Northway, Sec., Hamilton, Ohio

National Exposition of Power and Mechanical Engineering—New York City, December 7–13, 1922

American Malleable Castings Association—January 10, 1923, Robt. E. Bolt, Sec., 1900 Euclid Bldg., Cleveland, Ohio

National Jewelers Board of Trade—New York City, Jan. 18, 1923, F. C. Backus, Sec., 15 Maiden Lane, New York City

American Concrete Institute—February, 1923, Harvey Whipple, Sec., East Grand Boulevard at Moran, Detroit, Mich.

Optical Manufacturers Association—Monthly meetings, Ernest H. Gaunt, 511 Westminster St., Providence, R. I.

Gypsum Industries Association—H. H. McDonald, Sec., 111 Monroe St., Chicago, Ill.

National Lime Association, June 14–16, Hotel Statler, Cleveland, Ohio

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The Third Conference of the International Union of Pure and Applied Chemistry, June, 1922

The details concerning the importance of this conference are set forth editorially in the March issue of this *Journal*. Dr. E. W. Washburn with Dr. E. Ward Tillotson as alternate has been placed in nomination to the Division of Chemistry and Chemical Technology of the National Research Council as official representative of the American Ceramic Society.

Inter-Departmental Committee on Specifications for Refractories

The Bureau of Standards has been charged with the task of preparing specifications for refractories used by the various Federal Departments. The Bureau has asked the assistance of representatives of various industries to constitute an advisory committee and has also asked that the General Secretary of the American Ceramic Society serve as official representative of the Society. In conformity with this request the Board of Trustees has appointed Secretary Purdy as the Society's official representative.

All of the official personnel of the Refractories Division are serving on this Advisory Committee, having been appointed as official representatives of industrial groups.

The American Federation of Arts

This federation held its thirteenth annual convention in Washington, D. C., May 17–19, inclusive. Mr. Frederick H. Rhead, chairman of the Art Division, was appointed by President Riddle as delegate representing the American Ceramic Society.

Research Committee U. S. Potters Association

The meeting of the Research Committee of the U. S. Potters Association was held at the Bureau of Standards, Washington, D. C., on April 25th.

Tentative specifications for hotel ware were discussed and it was suggested that for vitreous ware the absorption for all hollow and flat ware, up to and including 8 inch dishes

should not exceed 1 per cent. No absorption requirement should be made for semi-vitreous ware. All ware, both vitreous and semi-vitreous should be required to withstand a quenching test from 175 degrees C to the temperature of tap water, repeated until it has been made five times. No items larger than five inches should be used for this test. The vitreous ware should be subjected to an impact test and should withstand a blow equivalent to 0.175 foot pound. No impact test should be required for semi-vitreous ware. Further work is to be done on the chipping, and abrasion tests and the effect of thickness upon the impact test is to be further investigated.

Mr. Larkins reported upon the use of cement for cases and the design of a kiln damper, Mr. Sproat on the use of cobalt sulphate as stain, Mr. Walker upon kiln dirt and saggers, Mr. Perice upon chemical tests for materials and Mr. Bleininger upon the question of normal water content of the materials and the control of the casting slip.

A discussion took place also of the possible standardization of the shapes and sizes of the most commonly used pottery items and the Bureau of Standards has agreed to undertake work along these lines. A comprehensive collection of different articles is to be arranged at the Bureau and a systematic survey of the situation attempted. It is hoped that at least for the purposes of the Government the shapes may be reduced in number and the sizes specified in a more satisfactory way.

National Research Council Division of Chemistry and Chemical Technology Annual Meeting

Excerpt from minutes of the annual meeting of the Division of Chemistry and Chemical Technology, held at the offices of the National Research Council, 1701 Massachusetts Avenue, Washington, D. C., April 24, 1922.

Present.—Messrs. W. D. Bancroft, A. V. Bleininger, F. G. Cottrell, Colin G. Fink, C. H. Herty, H. K. Moore, R. B. Moore, A. A. Noyes, Julius Stieglitz, E. W. Washburn. By invitation: Messrs. C. L. Parsons and C. J. West. Mr. W. Nichols acted as Secretary of the meeting.

Committee on Ceramic Research.—A. V. Bleininger, Chairman. Mr. Bleininger presented a brief report in behalf of his committee, stating that there had been no meeting of this joint committee during the past year, principally for two reasons—(1) the depressed state of the industries, and (2) the reorganization of the American Ceramic Society, which has expanded its activities and has created a permanent organization of well defined divisions. It is now proposed to offer to the National Research Council co-operation through a research committee composed of three members-at-large and one member chosen by each of seven divisions which represent the different industrial groups. As a result of this plan the present joint committee between the American Ceramic Society and the National Research Council should be discharged.

Mr. Cottrell then read a communication from the General Secretary of the American Ceramic Society, stating that the Society was now engaged in a complete reorganization, and that at the last meeting, February 27–March 3, in view of the contemplated changes in method of contact with the National Research Council, the joint committee between it and the National Research Council had been abolished, and that when the reorganization shall have been completed it is intended to make a presentation of this organization to the National Research Council with the purpose of developing the co-ordination in purpose and effort.

It was thereupon

Moved: That the report of the chairman be received and filed, and that the joint committee on Ceramic Research be discontinued.

Adopted.

Directory of Laboratories for Tests and Analysis of Ceramic Materials

A member of this Society wanted analysis made of some clays and after several unsuccessful enquiries sent his clays to England. Such enquiries come to the several federal bureaus and departments and to the ceramic departments of the Universities every week. Certainly there should be no difficulty in obtaining reliable tests and analysis of ceramic materials. There are several who are equipped to do such commercial testing.

The Board of Trustees of the American Ceramic Society has decided that the maintenance of a directory of laboratories in position to do commercial testing is one of the services which the Society should render. Those who will do such commercial testing are requested to give the Secretary's office (in confidence) a schedule of their facilities and charges. Members of the Society are asked to send in names of those by whom this notice will not be read.

The Secretary's office is now in co-operation with the U. S. Geological Survey in finding opportunities for such testing and it is intended that this co-operation shall be made general.

Here is opportunity for every member of the Society to co-operate in an enterprise for which there is an immediate demand. It is hoped the response to this appeal will be large.

On page 20 of the Advertising Section of the May issue there is a plan for classified advertising which will help to get these names before the public.

University Extension Courses

One of the first tasks of the Committee on Ceramic Education as provided by the amendment to the Constitution recently adopted, will be to develop the possibilities of University Extension Courses for persons employed in the ceramic industries. Dr. E. Ward Tillotson has been asked by the Board of Trustees to make a preliminary survey.

Here is an illuminating enquiry recently received.

> A little nigger "Carry-in-boy" in a Machine-Made Bottle Factory once made a suggestion that all of the mechanical genius had been over-looking for several years. The rest of that nigger's idea until he is 1256 years old may not be worth anything, and the one I want to spill at this time may not be either, but it can be disposed of quickly anyway.
>
> I got a list of the courses offered by the University Extension Division of University of Wisconsin recently to figure on some spare time work for myself, and it just occurred to me that the Glass Division of the American Ceramic Society could arrange with them for a selected course and endorse it for use by men in the factory like myself who never had the opportunity to take a resident school course. This, in time, would do the industry a lot of good.
>
> Regular subjects which the University of Wisconsin Extension offers that I notice are: "Heat," "Fuels," "Gas Producers" and "Compressed Air" in their Mechanical Engineering list, and "Elementary Geology," "Elementary Chemistry" and "Mineralogy."
>
> Could you not get such a course endorsed for men who do not know where to look for what will help them most?

Amendments to the Constitution

Out of 525 possible votes on the Amendments to the Constitution, 103 were cast with the following result:

Proposed Amendments	Yes	No
Wherever a representative of a Division or Section is indicated as a member of a committee, the words "selected by" shall be substituted for any phraseology used.	94	2
Article VI, Paragraph 1. "(10) Ceramic Education."	97	
Paragraph 13. "The Committee on Ceramic Education shall consist of a Chairman appointed by the Board of Trustees and one representative selected by each Division. This Committee shall make recommendations through the Board of Trustees for the betterment of ceramic education in institutions now established and for the encouragement of new departments of ceramics where the demand and facilities warrant."	97	1
Paragraph 14. "The Coördinating Service Council shall consist of the General Secretary, ex-officio chairman, and the chairmen of the Committees on Research, Standards, Geological Surveys, Data, and Ceramic Education. The Council shall have general supervision of the work of these Committees for the purpose of coördinating their work within the Society and with the work of other organizations on ceramic topics and problems."	101	1
Article X, Paragraph 1. "The Board of Trustees shall employ at suitable compensation an Editor of the Journal of the Society and an Advertising Manager, both of whom shall be nominated by the Committee on Publications to the Board of Trustees."	95	4

Each Amendment, therefore, is carried and, according to rule, at once becomes effective.

Membership Record

As might have been expected, the pace shown during and immediately after the Annual Meeting was too fast to continue. We have dropped a long distance to twenty-six new members in April. There is a gratifying side to this, however, in that thirteen of the twenty-six are Corporation Members. Supposing half of the members last month had been Corporation!

Also we call the attention of the general public to the record of the White Wares Division—eight new Corporation Members and three Associates. *No other Division* can compare with this, although each contributes some. The Heavy Clay Products Division has two Corporation and one Associate; the Enamel Division has one Corporation and two Associate; the Refractories Division has four Associate, and the Art and Glass Divisions have one each. There are two Corporation Members and one Associate not identified with any Division.

Analyses of the various industries have been undertaken by the office of the Secretary, showing the amount of representation in the Society held by each firm, and also showing the possibilities of the field. With this aid, and with renewed effort by officers and members, it should be possible to chalk up a better record next month.

One man alone is responsible for *six* of the Corporation and *one* of the Associate Members of the White Wares Division. He secured them by writing personal letters to a group of prospects. Another man sends in an average of one Corporation and one Associate Member *every month.* He does not make any noise but he writes *personal* letters.

How about writing two letters every day this month to persons you know who should be members? Have a sample copy of the new *Journal* sent to them and *write.*

New Members Received during April

ASSOCIATE

Armstrong, M. K., Hampton, Va.
Bentley, Fred, 72 Kelsey Ave., Trenton, N. J.
Bown, L. H., Buffalo, N. Y., General Manager, Buffalo Pottery
Butler, M. W., 14619 Coit Road, Cleveland, Ohio, Research Engineer, The Glass Coating Co.
Greene, Joseph F., 740 Pear St., Vineland, N. J., Kimble Glass Co.
Lodwick, J. A., 17 East 42nd St., New York City, American Arch Co.
Moodie, David M., Norwood, N. C.
Morgan, F. A., Anaconda Lead Products Co., Chicago, Ill.
Rivière, Mme. Jean, Jopyma Route du Cap-Brun, Toulon (Var), France
Seaton, Max Y., Sierra Magnesite Co., Porterville, Cal.
Vodicka, Albert L., Aetna Porcelain Enameling Co., 4701 Augusta St., Chicago, Ill.
Whipple, Allen D., 5241 N. Kimball Ave., Chicago, Ill.
Wildblood, A. F., 28 Wall St., Trenton, N. J.

CORPORATION

Batchelder-Wilson Co., 2633 Artesian St., Los Angeles, Cal.
Buffalo Pottery, Buffalo, N. Y.
Canonsburg Pottery Co., Canonsburg, Pa.
Canton Brick and Fireproofing Co., New Philadelphia, Ohio
Cook China Co., Trenton, N. J.
Crown Potteries Co., Evansville, Ind.
Interstate Corporation, Trenton, N. J.
Michigan Stove Co., Detroit, Mich.
National Lime Association, Washington, D. C.
Pope-Gosser China Co., Coshocton, Ohio
Stevens Bros. & Co., Stevens Pottery, Ga.
Western Electric Co., Hawthorne Station, Chicago, Ill.
H. R. Wyllie China Co., Huntington, W. Va.

Associates Elevated to Active Membership by the Board of Trustees, April, 1922

Abrams, Duff A.
Acheson, E. G.
Bachman, P. S.
Bacon, Charles C.
Baggs, A. E.
Bartells, H. H.
Beasley, H. C.
Bitting, A. W.
Brand, J. J. Fred
Bray, Archie C.
Brenner, R. F.
Buck, D. M.
Chandler, A. H.
Cooper, George W.
Crume, William H.
Dailey, Ernest W.
Dalton, Richard F.
Darlington, Homer T.
Davis, Harry E.
Donahoe, Frederick W.
Farren, Mabel C.
Flagg, F. P.
Flint, Francis C.
George, W. C.
Goodner, Ernest F.
Grant, W. Henry
Greenough, M. B.
Greenwood, G. W.
Hansen, J. E.
Helser, P. D.
Hill, Charles W.
Hill, James H.
Holmes, M. E.
Hower, H. S.
Hudson, Charles J.
Hunt, F. S.
Justice, I. M.
Keehn, C. C.
King, Earl O.
Knowles, Homer
Langworthy, H. S.
Larkins, Samuel
Leibson, J. S.
McDowell, S. J.
McGee, Earle N.
Manson, M. E.
Menne, L. H.
Merica, Paul D.

Moulton, D. A.
Muessig, C. N.
Parker, George W.
Pfalzgraf, Chas. F.
Randall, James E.
Reinecker, H. P.
Rusoff, Samuel
Schaeffer, John A.
Schramm, Edward
Smith, Perry A.
Smoot, C. E.
Stone, George C.
Thomas, Richard G.
Thwing, C. B.
Twells, Robert, Jr.
Vincent, Harry S.
Wainford, R. H.
Walker, Chas. H.
Weller, S. A.
Young, Russell T.
Zwerman, Carl H.

Who's Where in the American Ceramic Society

A note to the members: We try to keep the membership list constantly corrected. Naturally, however, changes of position and address are not known unless they are sent in. Sometimes we see notices in other periodicals touching the personnel of our membership. We always feel slighted when this occurs because we like to get the information direct. If we do not have correct addresses the Journal is not received, communications are lost, and both sides suffer. We wish members would make a point of notifying us when changes in address or position are made. It would help us to keep our records complete also if the company and position were always mentioned in such notification.

Robert E. Anderson is now associated with the Robertson Art Tile Co., at Trenton, N. J.

James L. Austin has recently accepted a position with the Carborundum Co., at Niagara Falls, N. Y.

George Blumenthal, Jr., has left the Bureau of Standards and is at Alfred, N. Y., where he will assist Professor Binns in the summer session of the Ceramic Department.

William B. Cleverly, formerly of Stoke-on-Trent, has become connected with the Carborundum Co. Ltd., at Manchester, England.

Paul P. Francais is now Enameling Superintendent of the A-B Stove Co., at Battle Creek, Mich.

H. W. Douda left the Bureau of Mines on April first and went to the National Fire Proofing Co., at East Palestine, Ohio.

Herbert Goodwin is superintendent of the Crescent China Co., Niles, Ohio.

H. W. Jackson has returned to DuBois, Pa., and is general manager of the Jackson Vitrified China Co.

T. A. Klinefelter, formerly superintendent of the Atlantic Terra Cotta Co., Tottenville, Staten Island, has gone to Trenton, N. J., where he is general manager of the pottery branch of the J. L. Mott Co.

G. Z. Minton, who is with the Pittsburgh Plate Glass Co., has been transferred from Creighton, Pa., to Kokomo, Ind.

William W. Paul has moved from Detroit, Mich., to Scranton, Pa.

A. E. Saunders has recently become Vice-President and Superintendent of the Oriental Art Glass Co., Chicago, Ill.

C. Saxton, formerly of France, is now agent in England for manufacturers of materials and apparatus, particularly for the glass industry. His office is at 35 Bedford St., Strand, London.

H. G. Schurecht has been connected with Mellon Institute, Pittsburgh, Pa., since April first.

C. A. Underwood, of the American Refractories Co., has been transferred from Valley, Wash., to Joliet, Ill.

On May 1, 1922, **R. T. Stull** was made Supervising Ceramist for the U. S. Bureau of Mines as a whole. He will have supervision in technical matters in ceramics, and related investigation of non-metallic minerals. He will have administrative as well as

technical supervision of field work in the kiln investigation carried out in co-operation with the four heavy clay products associations, including the car "HOLMES" and its crew. He will make his headquarters at Columbus, Ohio, but his services are available for consultation by all branches of the Bureau concerned with ceramics.

George A. Bole is Acting Superintendent of the Ceramic Experiment Station, at Columbus, Ohio, and as such acts in an advisory and consulting capacity to the Station in all of its ceramic work.

Say it with Words

We have been comparing the advertising pages of some numbers of the *Journal of the American Ceramic Society.* The figures are given below:

Space	Jan. 1918	Jan. 1919	Jan. 1920	Jan. 1921	May 1922
Full pages	4	7	6	8	11
Half pages	6	7	9	7	12
Quarter pages	5	4	3	6	11
Eighth pages	0	0	0	1	3
Total	$8^1/_4$	$11^1/_2$	$11^1/_4$	$13^1/_8$	$20^1/_8$

This is a considerable increase but not as large as it should be, and readers of the *Journal* are partly to blame. When you write to a manufacturer, do you tell him where you saw his advertisement? This is little trouble for you, but it helps the advertiser and the periodical mightily.

One of our advertisers says that while he believes his advertisement brings him business, he has no positive proof because no one has ever said that the advertisement was seen in the *Journal of the American Ceramic Society.* Will you notify your purchasing agent, or put it in your hat, to mention the *Journal* to advertisers?

Official Personnel of Divisions 1922–23

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NOTE ON REFRACTORIES ENGINEERING[1]

By W. E. Dornbach

ABSTRACT

A brief outline of training necessary to fit one for work as a Refractories Engineer. Nature of the work, its present-day importance and one verbal illustration of the work of such an Engineer.

Refractories engineering, that highly specialized branch of ceramics engineering, while not exactly a new profession, still in a sense might be called new inasmuch as its importance in the industry is just beginning to be truly appreciated. Every now and then we hear of a student in one or the other of our excellent ceramic engineering schools, who through broad vision or the advice of some real well wisher, has elected a special course of study in Ceramic Engineering which will fit him to specialize in the branch which we have under consideration. Our ceramic schools are well equipped for this work but it remains for the student to draw from the courses offered the essentials to make him a real refractories engineer. These essentials are a careful study of the principles of mechanical and electrical engineering; a thorough mastery of the work offered in metallurgy and a complete course in ceramics, with particular attention to refractories. The writer acknowledges that this is a very stiff curriculum and one that can not be carried out in the usual four-year college course unless the student is of exceptional ability. To specialize one must either put in additional time in college or the research laboratory or spend years in the actual pursuit of his special line. It is a sacrifice of time which is justified by the opportunities afforded in the end.

Refractories engineering is work usually of a consulting nature, or has been, with some exceptions, up to this time. It is now being employed as a profession in a wider range of work. Large refractories manufacturing concerns employ refractories engineers to work out difficult refractories problems that can not be definitely solved in the laboratories. Large steel works, copper and other metal working and refining industries also are awakening to the fact that competent refractories engineers are necessary to assist in the proper conduct of their manufacturing processes. In these instances the refractories engineer's work is similar to a doctor's. He, through his mechanical, electrical and metallurgical knowledge, diagnoses the faulty practice, determines why this refractory lining, roof or bottom is failing to give the proper service and then describes the cure, watching carefully the selection of materials and seeing that they are properly placed in the furnace or whatever the apparatus is upon which he is working. This can be nicely illustrated by the experience of one of the industry's most competent refractories engineers a few months ago. A large copper refinery, of international importance, had been using a reverberatory fired by hand with coal thru the means of a Dutch Oven. The heat in the re-

[1] Refractories Division, St. Louis Meeting, Feb. 28, 1922.

verberatory was about 2600°F under this process. The bottom was of silica sand, the side walls of magnesite brick and the roof was laid up of heavy silica shapes making it twenty inches thick. This company found that by eliminating the Dutch Oven and by feeding powdered coal direct to the reverberatory they could make one furnace take the place of four as operated under the old practice and that they could perfect a saving of 28% of the fuel formerly consumed. The result was that instead of obtaining 2600°F in their furnace the temperature increased to about 3200°F and the heavy silica roofs quickly burned out. Furthermore where the silica bottom and the magnesia brick joined, the magnesia brick quickly disintegrated through the attack of the silica at the increased temperature, leaving an unsupported side wall, which was liable to fall at any time, and removing all lining protection where the magnesia brick had disintegrated. This was an experience which none of the old and tried employees of this particular smelting company had ever seen before and they were at a loss as to how to remedy it. Finally our friend the refractories engineer was called on the job, with the result that in a very short time he properly diagnosed the trouble and prescribed the cure, which was highly successful. Perhaps the "cure" might be interesting: A thinner roof was recommended, namely, one of 12″ shapes, thin enough to allow thorough radiation, the release of the intensified heat against the crown, therefore lengthening the life of the silica brick. A magnesite bottom was recommended and installed for metallurgical reasons and thereby the silica bottom, which had such a ruinous effect on the magnesite side walls, was done away with, and the disintegration of the magnesite brick stopped. The recommendation of the magnesite bottom, alone, saved this company an immense amount of money as a purer product resulted, entirely eliminating the use of the blast furnace later in the process. This is just one of a hundred or more cares of refractories engineering that has come to the writer's attention since he has been interested in this subject.

The constant demands made upon the metallurgical industry for a better product, the improvements in furnace construction, the high price of fuel, labor and equipment, all have tended to influence remodelling of old furnace equipment and the development of new and more efficient furnaces. This all means work for the refractories engineer as he is truly the court of last appeal when a radical change or a new furnace is perfected. It is as truly important that a lining be properly fitted to a furnace and process as it is that a potter produce a glaze that fits perfectly to his body or bisque. The advent of the electric furnace has probably had more to do with the development of the refractories engineer than any one type of furnace. Every now and then we hear of a new type being perfected or an old type being put to a new use, where a new lining must be installed. Rule of thumb methods are still, sad to say, being used in a great number of metallurgical and non-

metal producing plants where high grade refractories are used or abused. This method can not survive the demands which our present-day competition makes on the furnace user. Why line a cupola with expensive basic refractories when low priced fire-brick will even better answer the purpose, just because it has been the practice at this particular plant to do this? This is an actual condition which came under the writer's observation, and he leaves it to the reader to estimate the operating costs on this cupola. Are refractories engineers needed? Most emphatically yes. And the time will shortly arrive when more young ceramic engineers will enter this most important field.

Discussion

By A. F. Greaves-Walker.—Mr. Dornbach's paper brings out quite forcibly the need of the refractories industry for specially trained engineers. The colleges give an excellent opportunity for training such men, but it is, of course, more or less up to the men themselves to determine whether to take up this work and select their courses accordingly.

The particular requirements of a refractories engineer are a good ceramic training with special emphasis on refractories; a thorough knowledge of metallurgy and metallurgical furnace design; a good grounding in electrical engineering in order that pace may be kept with the rapidly developing electric furnace; a thorough knowledge of the principles of combustion, furnace design and fuels, and a good knowledge of geology. This latter is required because of the necessity of knowing the ores, fuel and raw materials with which the engineer has to deal.

In the past few years there has been a constant demand for men with this training in both the refractories and metallurgical industries, but there are no trained men available. It has even become necessary to have engineers on the sales forces of the refractories companies due to the demand of the consumer for salesmen who could diagnose his requirements and sell him the proper refractories.

With such an excellent opportunity for young men in a comparatively new field, it is hoped that more of our ceramic students will grasp it and take up the new work.

EXTENSION WORK[1]

By Paul E. Cox

ABSTRACT

The work in Engineering Extension at Iowa State College has been furthered by popular lectures supported by work on the potter's wheel, thereby getting before 40,000 members of Women's Clubs the fact that the ceramic profession is a vital factor in home life from many angles. It is shown how easily and cheaply such development work can be done.

In the late fall of 1920 Mrs. Lillian Crowley, Des Moines, Iowa, applied to the writer in behalf of the General Federation of Women's Clubs for

[1] Art Division, St. Louis Meeting, Feb. 28, 1922.

data for a paper to be printed in the Des Moines Register in the page devoted to things of interest to women. This came about for the reason that Iowa State College has a very large Home Economics Division and many of the young women come into the Department of Ceramics for training in pottery making, with the expectation, of course, that this work may prove of service to them in their teaching work later on. Mrs. Crowley became interested as is the case with most people in the work the writer happened to be doing on the wheel and an invitation was extended that brought about the extension work to be spoken of.

The writer built a potter's wheel of a special sort, so arranged that all the parts could be taken down and boxed up in the "crib" of the wheel, so that easy shipment could be had, the "crib" being the container for the rest of the machine. This makes a package of about 350 pounds and when the wheel is set up the machine is a rather rough-and-ready specimen of the old-fashioned kick wheel of the sort used by the country shops of stoneware pottery days. Clay is then carried along by the writer and with the few simple tools needed for such work it is possible to demonstrate the process of forming a vase in the rooms selected by the club women as a place for the show.

The first talk was in Des Moines under the patronage of the Fine Arts Association and this talk was repeated this year again. With the newspaper notices to suggest it, the Department of Engineering Extension head, Professor Faber, saw that a new activity was ready made for him and the writer has delivered from one to three talks a month all the year and has been compelled to refuse many other invitations, because of the fact that women can not readily put aside household cares on Saturdays and teachers have classes in the week days that interfere on their side with mid-week engagements. It is plain to be seen, however, that such work, properly handled, is easily a way to bring the knowledge of what ceramics folks are doing to a very large circle of people. In Iowa this work extends a knowledge of ceramics as an engineering profession to an organization consisting of 40,000 women, most of them mothers of sons and daughters who are potential students of ceramics or else potential consumers of the products of the ceramic arts and manufactures.

The wheel is sufficiently out of date so that it is a great attraction to nearly every person because it is no longer a familiar tool. With the wheel, a few lantern slides and a popular talk it is easy to hold an audience for two hours, and while no charge is made for the service, other than expenses, the writer has been gratified by the reports that come in about the interest shown, and by the desire to have this service in the several little cities of Iowa.

The talk deals not with art pottery but with pottery in general and from the standpoint of body composition and technical considerations generally.

Naturally the talk is reduced to simple terms, and is calculated to bring up the elderly lady with the heirloom with a question showing her pride in its possession. The real idea is to get before each group exactly what the field of ceramics covers, how to select dishes for the household use, and what the American and studio art potteries have to make the home more interesting. Out of this ought to grow benefit to the ceramic profession generally, as these women are the home makers of a commonwealth. And out of it ought to develop interest in the product of those interested in the Art Division, as every vase offered for sale will have more interest after common Iowa shale has been formed before them into pottery which can be handled and talked about with the maker. The pottery is brought to them instead of their visiting the pottery. And the shale chosen is one widely advertised as being used in a building block, so that mention of the source of the raw material brings home to them the lesson of what training can do with very simple material. Not yet has the writer failed to have to answer that water and Iowa shale made the mixture used.

The reaction on the Iowa State College is of less interest to those not of that institution but it has been found well worth while to have this work done and the authorities recognize the advertising value of this sort of thing. In token of this recognition the plan is being urged of the establishment of a studio pottery, with a competent artist doing the design work, who will use a part of the time to train others to make up a staff of several workers. This is decidedly an endorsement of what the Art Division is preaching, for this work is being initiated in the Engineering Division with the frank acknowledgment, or rather with the far-sightedness of a good administrator, that engineering and all other arts and sciences are mutually dependent one on the other, and that the young man or woman with a bent for crafts work needs direction and the chance to have it, whether it be to build a better looking machine or a better looking vase.

It would seem therefore that in every community similar extension work could be developed. The person is unwise who does not see the tremendous influence that women have in American life, for women are the great purchasing mass after all. Women can best be reached in the interests of ceramics as a profession, through the Art Division group. It is this idea therefore that prompts the writer to submit a paper hardly of a character to deserve attention in a body like the American Ceramic Society, otherwise. It should be noted, however, that few students enter any college unfamiliar with what the names "civil engineer" or "chemical engineer" or other engineering professions' names have to do but certainly out of the several hundreds entering Iowa State College each year there are few to whom the word "ceramics" has a meaning of any sort and a canvas of the membership of the Society would show a considerable number who had taken up the study of the profession because of having their curiosity excited by seeing

interesting work going on where that unfamiliar word was being used by a small but busy group of people. The extension work has been done cheaply and effectively and has reached directly and indirectly a wide circle of household managers. Teachers of art in high schools and colleges have been eager listeners and there is a great and real interest in exactly what the Art Division proposes to do. And this that the Art Division proposes to do will get before a great public what an influence the ceramist is to be and has always been in daily life. In other words the Art Division can very well be the publicity department of the American Ceramic Society so far as the lay people are concerned.

Department of Ceramics
Iowa State College
Ames, Iowa

ITEMS OF COST FREQUENTLY OVERLOOKED[1]

By F. T. Owens

There will be some of you who will no doubt wonder what particular items of cost there could be that are not included in your books and it is possible that none of you have these to contend with, but it is a matter of record that most manufacturers fail to consider some of the items that are causing serious losses and are often overlooked.

Many manufacturers are enjoying a false security because they do not keep an absolute record. For instance, in the manufacture of brick or hollow ware, a certain percentage is placed on the dryer cars without being recorded with the thought that this will take care of all breakage due to the drying and burning. Would it not be much better to have an absolute count, keeping a record of the breakage in dryer and kilns and find out just what the breakage is? For it is only by giving these matters due consideration and studying their importance that we endeavor to correct them.

Another source of loss comes in the lack of proper sense of proportion between costs and selling price, but before taking that up, it might be well to consider the question of costs from another standpoint. Assume that a machine production of 987,000 brick for the month is reported at a cost of $16,650.69. This is the machine production and shows us a cost of $16.87. However, we find a dryer breakage of 2%, a kiln breakage of 5%, which decreases the net production to the figures of 917,910 brick and increases the $16.87 cost to $18.47 per M. We find also that 10% of the production are seconds, which have to be sold at $2.00 less than the actual cost price, thus raising the cost of the first quality ware to $18.43, which is a net difference of $1.56 between the figures we first had and those we get finally.

On the first figures of $16.87 we would add sufficient to bring the selling

[1] Heavy Clay Products Division, St. Louis Meeting, Feb. 28, 1922.

price to \$19.50. This would allow us a profit of 12.8%, but on the revised figures we find the profit is only $5^1/_2$%.

In the figures quoted above there is nothing for idle time throughout the year and the manufacturer who sits down and figures the cost for one month and believes that he can sell for the succeeding ninety days on the basis of that first month's costs is seriously fooling himself.

What manufacturing business can afford to push ahead, put in improved methods and machines on a selling price of 12% above cost of production? The smallest margin that any manufacturer should consider should be 20%. In other words, if the unit of sale costs \$16.00, then it should sell for \$20.00, which allows that 20% of the selling price for profit above cost and I think that those of you who have been in the brick business will agree with me that a four dollar profit at the factory end is something we have rarely heard of, except in a few cases where a highly specialized brick is being considered. Aside from the war times, the hollow tile manufacturers and the common brick manufacturers have found themselves in a no more favorable situation.

A basis of costs figured on any one month's production can not show you the results unless continuous operation throughout the entire twelve months of the year can be had. There may be some who can have a clay plant idle without having any expense attached, but such a plant would be worth little when it was started up anew, for some one must be looking after it day by day or a very serious depreciation comes so that when it is time to start the plant heavy repair bills must be met. It is fair to assume that the average plant producing 120 tons of material per day has an overhead of approximately \$1000 per month in interest charges, insurance, up-keep, watchman, heating, water, etc., and if such a plant is down for three months, then the overhead of those three months must be distributed throughout the cost the entire year. Unless this is done the manufacturer is going to find himself disappointed when the annual balance sheet is made up.

Depreciation must be given due consideration and if this is not done, after a term of years the manufacturer will find himself with a plant worth less than the representation in capital stock on his books. An item of depreciation is properly chargeable in your costs and should appear there. If this is not done, it can only mean a loss in the long run.

There is another item of cost which should have very careful attention and this is in the off-quality material. Some of you may not be troubled with this, but then again, others find it quite a problem. Assume for the moment that you are making a material on which you have determined your cost to be approximately \$20 per unit, after giving consideration to your second quality ware and breakage. The experience in the past has been that, on a cost of \$20, one dollar or one dollar and a half would be

plenty to add for profit. Now let us see what happens. In the production of a million of first-quality ware we get 200,000 that are off shade or off quality so that the unit price drops to $18 per M. This means a two dollar loss or $400, which must be considered in the selling price of the strictly first-class ware, or a matter of $.50 per unit. This point has been missed in the past and is being missed by a great many manufacturers today and accounts, in many instances, for the disappointment of the Board of Directors when they consider the profits for the year and find that instead of a 10% dividend they can only make it three or four.

At this point it might be well to consider another problem that faces us today. The indications are that the next five years will see some wonderful developments in the manufacture of heavy clay wares and it is not beyond the realm of possibility that many of the plants in service today will be out of date five years hence. This brings to our minds the thought, should we not provide for obsolescence as well as depreciation? Assume that a plant stands at $100,000 today and that thirty thousand of this investment will become obsolete in five years. Should we not make provisions to take care of this? Otherwise, how will the improvement be paid for when it must be put in? We would find serious difficulty in providing for this day under our present income tax law and it is a serious problem that should have our careful consideration and be brought to the attention of those who can afford us relief.

We have heard a great deal about deflation and the reduction of living costs, etc., but those of us who have had to travel much during the last year have found, in many instances, costs have not receded any from the war time rates and we naturally wonder why. If you will give consideration to the following thought, we believe you will see why. We have in this country two large strings of hotels. With one of these it is the purpose of the managing board to build one new hotel each year from the profits of the others and as such a hotel costs today about $2,000,000 fully equipped, you can see that in order to have $2,000,000 net gain over dividends to put in a new enterprise they must pay our good old Uncle Sam a handsome income tax. To do this they are taking it from the man who finds it necessary to travel from point to point to earn his daily bread. If you have figured out on your plant that thirty thousand dollars made in 1922 will afford the return on the capital invested that you think is adequate, are you figuring to earn enough for Uncle Sam so that you may be allowed to pay the desired amount to your stockholders? If not, you had better give this consideration, else you will find when you come to make up your balance sheet that the profits have again vanished.

Some time ago the writer had occasion to check up some figures on a plant to see why burning costs had suddenly risen and after a careful comparison was made of a number of kiln records, it was found that nearly

10% less ware was being placed in the kilns than had formerly been done, with a consequent sharp rise in burning costs.

It is only by keeping very careful records and then checking the records of one period against those of another that we can find the reason for rising costs and a careful analysis should be made at all times of the costs as they are shown from time to time so that occurrences, such as we have noted, may be quickly brought to light and corrected.

If we could imbue the employees with the thought that they are working with the material, which while only raw clay to start with, has added to it gold in the shape of labor as it goes from process to process, they might consider it from a different standpoint and use more care in its handling and take more pride in seeing that the final result is that which is hoped for.

We must get our men away from the thought of being ordinary mud mixers and get them to see, if possible, that working in clay to produce hollow ware, floor tile, roofing tile, face brick, common brick or any similar ware is just as honorable as the production of the finest chinas or glass ware.

In closing allow me to urge upon you the adoption of uniform cost system with your fellow manufacturers so that when you come to compare costs (and this I urge upon you most strongly), you will be talking about the same thing in exactly the same way and when the golden day arrives that we can sit down and talk about our costs, each of us talking on about the same basis, then indeed we will be making a greater progress than has been shown heretofore.

NOTES ON GREEN STAINING OF CLAY WARE[1]

By C. W. Hill

The cause of yellow-green staining which sometimes occurs on ceramic products on exposure to weather has usually been attributed to compounds of vanadium. The explanation probably had its origin in the investigations of Seger who appears to have established the presence of vanadium in the material examined by him. The view has been perpetuated in the literature by several American and English ceramists and is that of nearly all the ceramists with whom the subject has been discussed.

A case was brought to the writer's attention several years ago of green stain on ware made from clay which was known to contain a small amount of pyrites. A sample of the stain was digested with various acids but the solution failed to give a test for iron. The dried stain was fused with an alkali and the fusion dissolved in hydrochloric acid. This solution gave a heavy iron test. Upon neutralization with ammonia a white flocculent precipitate was obtained, indicating that the iron had been combined with alumina or silica.

[1] Terra Cotta Division, St. Louis Meeting, Feb. 28, 1922.

This test has since been repeated with a positive test for iron whenever examples of green staining could be found.

The stain is dissolved by oxalic acid solution or by a solution of alum acidified by sulphuric acid, the latter having been brought to our attention by Mr. George Facht. Either of these solutions if sufficiently concentrated gives an iron test.

The tendency toward green staining is present in buff burning clays, which burn "soft," that is, have a high absorption. We understand that manufacturers of buff face brick overcame the difficulty either by burning at a higher temperature or by addition of a tighter burning clay. Whether the first remedy is due entirely to the decreased absorption of the product with decreased leaching action of water or in part due to the fixation of the iron in a less soluble compound, we are not prepared to say. The point is doubtless one of theoretical interest and not of practical value. When the ware is covered with a slip the green staining may be avoided by use of a "hard" slip, without resorting to higher burning.

The absence of iron in Seger's analysis as well as certain differences in chemical behavior and appearance of the stain he describes would indicate that this was of a different nature than the stains we have investigated. Our experience, however, would indicate the desirability of testing for iron by fusion before assuming that vanadium is the cause of any green stain. We are inclined to believe that with Eastern and Central clays the stain is probably entirely due to iron. We have not tested the stain on Western clays which may possibly contain vanadium and resemble the clay tested by Seger.

DISCUSSIONS OF "THE ADAPTABILITY OF THE GAS FIRED COMPARTMENT KILN FOR THE BURNING OF CLAY PRODUCTS"[1]

BY C. B. HARROP:—Mr. Richardson is advocating the use of a kiln which, under certain conditions and for certain wares, is a very desirable type and is surely going to be installed for white wares in the near future.

Provided the initial investment is not prohibitive, a fuel saving of over 50 per cent will enable the owner of this kiln to show the stockholders a neat increase in annual profits or else it will enable him to cut the price of this product to a point that will be of very serious concern to his less progressive competitor.

The author calls attention to the fact that when describing the performance of the car tunnel kiln, "comparisons have always been made with the old periodic kiln and not with the latest developed continuous kilns of other types." He then proceeds to compare the performance of the compartment kiln, which he is advocating, with the same "old periodic kiln."

[1] Richardson, *Jour. Am. Ceram. Soc.*, **5**, 254 (1922).

Personally, I feel that a comparison of either type of continuous kiln with the periodic kiln is perfectly justifiable, for it is this wasteful kiln that we are all anxious to see supplanted with a modern and more economical structure. As a matter of fact, I doubt if there is a clayworking plant in the United States where both the moving-fire-zone continuous kiln and the car tunnel kiln can be found, while almost invariably are there periodic kilns at the same plant with either type of continuous kiln. If we compare both types of continuous kiln with the periodic kiln, we can readily compare the performance of the two continuous kilns with each other.

The author states that the continuous compartment kiln for heavy wares operating on the same yard with periodic kilns has shown a fuel saving of *more than 50 per cent.* This is a saving that should attract the attention of every progressive manufacturer. However, it should be mentioned here that on a number of car tunnel kiln installations handling white wares, the fuel saving, over former periodic kiln operation, is 75 per cent and even higher in some instances.

Under No. 4 of the author's summary, he states that in a car tunnel kiln, the capacity is limited because a "strong draft does not distribute the heat properly." I do not believe that he is justified in making this statement, as the writer can exhibit several installations of the car tunnel kiln, operating at high production, in which the temperature variations over the cross-section of the ware are practically nil.

The author makes the statement that repairs can be made more readily in the compartment kiln than in the car tunnel kiln. It should be pointed out in this connection that, as the temperature in any part of the tunnel kiln is held practically constant at all times, expansion and contraction trouble are conspicuous by their absence. The car platforms are the only parts to suffer from this action, which is so prevalent in periodic and moving-fire-zone continuous kilns and they are attended to on the outside and interfere in no way with the operation of the kiln.

The author does not allude to the cost of installing a compartment continuous kiln. Figures on the cost of this kiln for a given capacity would be very interesting and valuable for comparison purposes.

By A. F. Greaves-Walker:—There can be little question but that it has been amply demonstrated that the gas fired compartment kiln can successfully replace the present types of periodic kilns used in any branch of the industry with an assured saving of at least 50% in the cost of operation.

Many kilns of this type have been built in this country for use in burning heavy clay products, the majority of which are or have been successfully operated. Failures or partial failure or the failure to come up to expectations have been due, in every case the writer has investigated, to poor construction or failure to follow good engineering practice.

There is a great question as to whether the railroad tunnel kiln will ever come into general use in the heavy clay products industry due to the obvious limits on the capacity and the space required for installation. In this branch the continuous kiln is, at present, the only solution of the burning problem.

However, it is the writer's opinion that the railroad tunnel kiln has demonstrated that it is the ideal type for the pottery industry and while the continuous compartment type may be used in isolated instances, it will never become popular.

DISCUSSION OF "PHYSICAL DEFECTS IN TANK BLOCKS"[1]

By W. Angus McIntyre:—Fig. 1. Two sets of trend lines are seen. The diagonal ones correspond to the laminations and the less permanent horizontal set is found only toward the sides of the block.

Fig. 1.

[1] Loomis, *Jour. Am. Ceram. Soc.*, **5**, 102 (1922).

FIG. 2.

FIG. 3.

Fig. 2 is typical of most of the blocks I have examined. In addition to several cavities and numerous pinholes irregularly arranged there are concentric laminations which gradually flatten out toward the top and for the last $^3/_8''$ become quite horizontal when enlarged up to 3-4 diameters.

Fig. 3 is a fragment of a block which has stood up fairly well in practice. In this the pinholes and cavities are just as numerous as in the previous

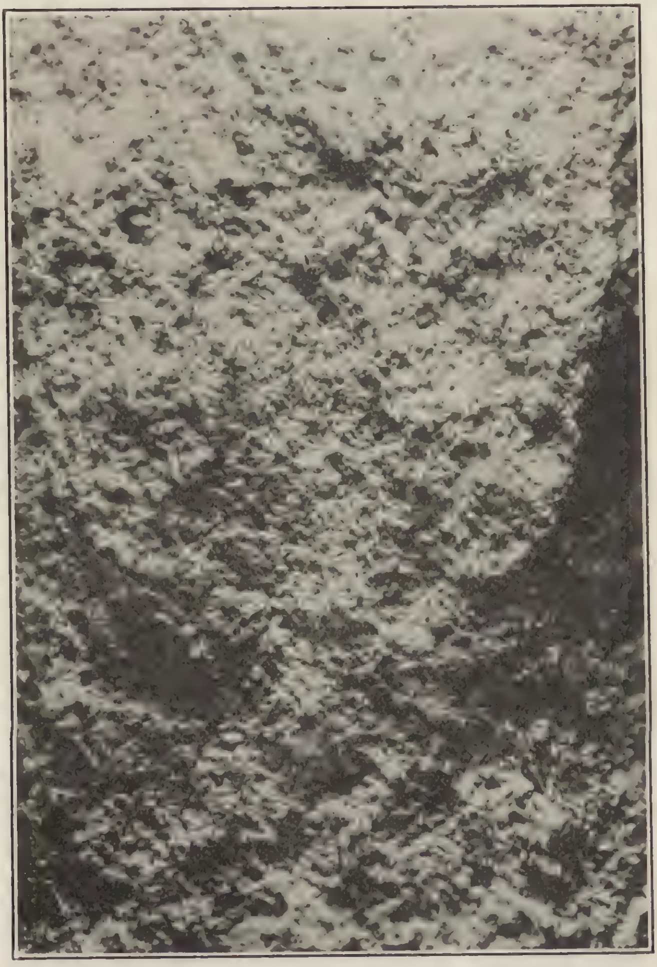

Fig. 4.

specimen, but even on enlarging only one set of trend lines can be seen and they bear no apparent relationship to the edges of the block.

In attempting to prepare microscopic sections of these blocks it was found that the specimens tend to fracture much more readily in the direction of these various trend lines and the structure appears to persist throughout the blocks down to a very fine scale.

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BULLETIN
of the
American Ceramic Society

A Monthly Publication Devoted to Proceedings of the Society, Discussions of Plant Problems, Discussions of Technical and Scientific Questions and Promotion of Coöperative Research

Edited by the Secretary of the Society Assisted by Officers of the Industrial Divisions

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B. T. Sweely, R. R. Danielson — Enamel
J. C. Hostetter, A. E. Williams — Glass
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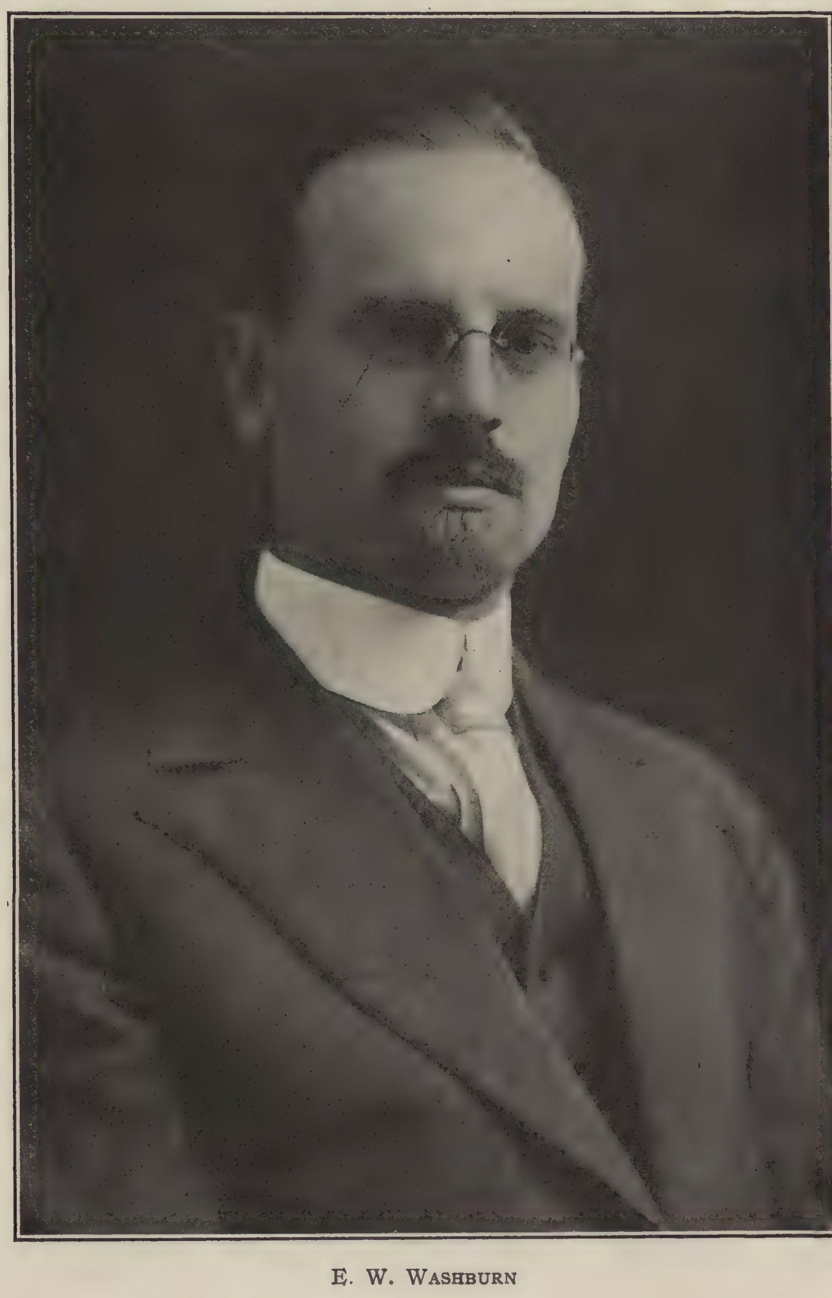
Vol. 1 July, 1922 No. 3

EDITORIALS

DR. EDWARD W. WASHBURN

A Sketch and a Tribute

For six years Dr. E. W. Washburn has been the directing head of the department of Ceramic Engineering at the University of Illinois and during the past year he has been editor-in-chief of the *Journal of the American Ceramic Society*. During these six years he has contributed to ceramic science from the viewpoint of a physical chemist with a peculiar gift for searching and proving fundamentals. His laboratory at the University is equipped with devices that are unusual to ceramic laboratories but the discoveries there made have been told by Dr. Washburn in such an elementary fashion that most of us have not an adequate appreciation of the ingenious methods and painstaking thoroughness by which he has derived fundamental facts, concerning which ceramists have long been theorizing from empirical observations. One must study his contributions and know something of the methods used to appreciate the value of that which Dr. Washburn has contributed during these six years. Only thus can an estimate be made of the loss which ceramic science will feel because of his withdrawal from this special field. His new work takes him to Washington, D. C., where he will be editor-in-chief of "International Critical Tables of Physical, Chemical, and Engineering Constants," and chairman of the Division of Chemistry and Chemical Technology of the National Research Council.



E. W. WASHBURN

The present editor of this *Journal* confidently expresses for all members of the Society sincere gratitude to Dr. Washburn for his contributions to ceramic science and especially for the services he efficiently rendered as member of the Research Committee during the past four years and as editor of this *Journal* during 1921. It is hoped that the Society will be favored by a continuance of his interest and assistance in the things it aims to accomplish. He enters into a broader field of science with the best wishes of every member of this Society.

We recite here from "Who's Who" a résumé of what he has achieved: Chemist: Univ. of Nebr., 1899–1901; Mass. Inst. Tech., B.S. 1905, Ph.D. 1908; Research assoc. in physical chemistry, Mass. Inst. Tech., 1906–08; Assoc. in chem., 1908–10, Assist. prof., 1910–13; Prof. physical chem., 1913–16; Prof. ceramic chem., and head of dept. of ceramic engineering, 1916–22; U. of Ill. Editor-in-chief Internat. Critical Tables of Phys., Chem. and Engrng. Constants, 1922—Vice-chmn. and acting chmn., 1918–19 Chmn. 1922–23, Div. of chem. and chem. tech., Natl. Research Council; Delegate to Internat. Union Pure and Appl. Chem., London, 1919, Lyons, 1922 and to Internat. Research Council, Brussels, 1919 and 1922; Amer. Commissioner Internat. Annual Tables of Phys. and Chem. Constants, 1921. Fel. A.A.A.S., Mem. Am. Chem. Soc., Am. Phys. Soc., Am. Ceramic Soc. (Ed. "Jour." 1921), Nat. Research Council, Soc. Glass Technology, Roy. Soc. Arts; Ill. Acad. Sci., Phi Lambda Upsilon, Sigma Xi, Mass. Soc. Mayflower Des., Colonial Families. *Author:* Introduction to the Principles of Physical Chemistry, McGraw-Hill Book Co., New York, 1915, 2nd. Ed. 1921, French translation by Noyes and Weiss, Payot et Cie, Paris, 1922; sixty contributions to scientific and technical press embodying results of original research. *Clubs:* Cosmos, Washington, D. C., Chemists, N. Y., University, Urbana, Ill. *Address:* National Research Council, Washington, D. C.

His researches and publications are:

A. Introduction to the Principles of Physical Chemistry.

The McGraw-Hill Book Co., New York. 1915. Pp. xxv + 445. 2nd. Edition 1921. Pp. xxvii + 500.

1. The Theory and Practice of the Iodometric Determination of Arsenious Acid. *J. Amer. Chem. Soc.*, **30**, 31 (1908).

2. An Improved Apparatus for the Measurement of Transference Numbers in Solutions of the Halogen Acids and their Salts. *Technology Quarterly*, **21**, 164 (1908).

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66. The Viscosities of the Soda-Lime-Silica Glasses between 800° and 1500°C. (With G. R. Shelton.)

67. The Surface Tensions of the Soda-Lime-Silica Glasses at High Temperatures. (With E. E. Libman.)

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69. The Products of the Calcination of Flint and Chalcedony. (With L. Navias.)

TWO NOTABLE EVENTS MARK PROGRESS IN CERAMIC ENGINEERING

Edward Orton, Jr. Made Doctor of Science

New Jersey Ceramic Research Station Building Dedicated

Rutgers College honored itself and gave recognition to Ceramic Engineering as an applied science when on June 13th it conferred the degree of Doctor of Science upon Edward Orton, Jr. and dedicated a handsome and well-equipped building to the teaching of, and for, research in Ceramics.

For over 150 years Rutgers College has maintained an enviable research record in the classics and in the pure sciences and no deviation was made from her traditional conservatism when she in this substantial manner recognized Ceramics as a science.

Prof. George H. Brown.

For twenty years Rutgers College has been offering courses of instruction in Ceramics and maintaining ceramic research laboratories. These twenty years have been years of substantial accomplishments in Ceramic technology and of increasing recognition and support of scientific and technical research by the Ceramic industries.

In 1894 the first collegiate course of instruction in Ceramic Engineering was opened to students at the Ohio State University under the directorship of Edward Orton, Jr. Four years later the American Ceramic Society was organized by him. In rapid succession similar courses of ceramic instruction and ceramic research stations were established in the states of New York, New Jersey,

Illinois, Iowa, Oregon, North Dakota, Washington and in Saskatoon, Canada, in federal bureaus, and in several European countries. Societies for the promotion of Ceramic arts and sciences have been established in England, France, Germany and Japan. The Dean of this world-wide organization for the promotion of ceramic arts and sciences is our own Edward Orton, Jr., who for twenty years was secretary of the American

Edward Orton, Jr., E.M., D.S.

Albert V. Bleininger.

Ceramic Society. It was very fitting, therefore, that Rutgers College with its 150 years of traditions should, on the 20th anniversary of the establishing of its own ceramic department, give recognition and honor to him to whom belongs the credit for initiating this world-wide promotion of Ceramic technology and science.

Left to right: Abel Hansen, Charles H. Cook, Frank H. Riddle, Dr. W. H. S. Demarest, Prof. George H. Brown, Roy H. Minton.

Prof. George H. Brown is the Director of the New Jersey Ceramic Research Station. To him belongs the lion's share of credit for obtaining the handsome and well appointed building on Rutgers campus. He was loyally supported by the New Jersey Clay Workers under the

Charles A. Bloomfield. Dr. Edward Orton, Jr.

leadership of Charles A. Bloomfield, Charles H. Cook, Abel Hansen, August Staudt, past presidents of the New Jersey Clay Workers Association, and by Roy H. Minton, the present president. $100,000 was given by the State and the equivalent of $30,000 was contributed by the clay workers.

The purposes of this Ceramic Research Station are:

1. To give instruction in Ceramic Engineering and in Ceramic Arts and Sciences.
2. To conduct Extension Courses in Ceramics in different centers throughout the State.
3. To Conduct Coöperative Industrial Researches.
4. To investigate the resources of the State ceramic materials.
5. To publish Ceramic literature.

We confidently bespeak for the Ceramic workers the world around a self-congratulation that the State of New Jersey has so well equipped herself for the training of ceramists and for the prosecution of ceramic investigations. These facilities, though they will be maintained by New Jersey, will be an addition to the facilities of the entire ceramic craft the world around.

THE VALUE OF DISCUSSIONS

Growth: the Interchange of Ideas.—Since the founding of the American Ceramic Society the custom of the Annual Meetings has been to carry on the activities of the Society through the medium of *Discussions.* The need for this interchange of ideas was, in fact, the fundamental reason for the organization of the Society. If everyone had felt complete master of his work, with no difficulties to encounter and no problems to solve, each would have continued to go his separate way content. There would have been no desire for lengthy trips which meant time lost and money and energy expended. And in the end this narrow, ingrowing spirit would have meant a retrogression and serious crippling of business. *Isolation does not encourage progress.*

The reason, then, for these meetings was the need felt by the scientific man and the practical business man to get together and contribute to the experience of others as well as to accept their share. Each one recognized his limitations and sensed the value of the ideas of the others. This interchange of ideas has always stood for growth and in the Society it meant development from a few score of men to many hundreds.

Thoroughness of the Early Years.—But with the increase in membership in the Society new difficulties arose. In the early days, when the number was small, the men knew each other intimately and their problems took on the aspect of personal difficulties. Each one was considered at length and thoroughly discussed. In the older volumes of the *Transactions*, all of the members were active participants in these discussions. They were intimate and companionable, and yet, informal as they were, the results were far-reaching and conclusive. A problem was not left until the solution was made as complete as these men could work it out.

If a definite end could not be obtained, the discussions were continued throughout the year by correspondence and the questions were reconsidered at the next Annual Meeting. Thoroughness characterizes these discussions as they appear now in the *Transactions.*

Discussions Supplement Annual Meeting.—Necessarily, with the remarkable increase in the Society membership, the attendance at the meetings has become a matter of hundreds rather than the few score as at first. The affairs of the Society demand more time; there are more problems, but no more time. One of the most frequent expressions during the progress of a heated discussion is "This must be continued at another time." There are many other papers to be heard; many other questions of just as vital importance to be taken up and probably left unfinished. And then the meeting is over. A few copies of the Reports are circulated among the officers. Otherwise, the questions discussed are dead issues, the solutions of problems lost.

This, then, is the first purpose of opening the pages of the *Bulletin* to the members for Discussions. There is the opportunity of preserving the record of the results of the meetings as well as carrying the subject much further and working out new phases and solutions. Objections may be brought up and confusing questions explained. In other words, the meeting is over, but the forum is once more open and Discussions are going full tilt.

Open Forum for the Society.—A second, but by no means less, consideration is the matter of the thousand or more members who have not been present at the meeting. They have as many problems of vital importance to work out and as many ideas of worth to offer to others but without a medium of expression their aid is impossible. With the presentation of the Discussions they are not only given the benefit of the transactions which they have missed, but they are invited to contribute to these same Discussions; to add their weight of experience. Not only to themselves but to the entire Society, these members take on a new significance for they are contributing to the welfare of the Society as well as deriving benefits from its organization. For the first time, the bulk of the Society is made to feel an active interest which hitherto has been denied. They recreated themselves into an active, working force which is ready to offer to the Society aid to the uttermost limit.

Keeps Subjects Active.—In addition to papers presented at the meetings and the discussions which follow them, there are many papers published which are received in the Editor's office not in connection with a meeting. These papers are vital and alive. Their problems and issues are current and as essential as any given consideration at the meetings. The members are losing a great deal not to use these for Discussions. The idea that a paper which was published last year is a dead issue is

fundamentally wrong. The *Journals* themselves are of more than current interest. Their scope includes subjects of interest to every member. They are current and alive until a new idea is presented to displace them.

Vitality of Discussions.—And so the *Bulletin* herewith presents the opportunity for this exchange of ideas. It is the organ of expression for the fifteen hundred members of the Society. A few score of men write the original papers which interest and demand the criticism of the entire Society. And it is in the *Bulletin* that these new voices must be heard. The *Bulletin* belongs to these fifteen hundred members in the seven Divisions, and it will become the thing they decree it to be. This is every member's opportunity to express ideas and ask questions.

The *Bulletin* will then be vital.

ACTIVITIES OF THE SOCIETY

U. S. Bureau of Mines

Laboratory Car "Holmes"

The accompanying illustration shows the gang of good men and true whose duty it is to keep the "Holmes" fires burning. The car is being used to visit different brick plants in the general region of Ohio for the observation of firing methods employed and the pointing out of wasteful practices and opportunities for improvement that should

Experimental Laboratory on the "Holmes."

Crew of Laboratory Car "Holmes," U. S. Bureau of Mines. Reading from left to right: Wm. Rice, A. R. Mumford, P. S. Bachman, Robt. Lunger, E. B. Baker, R. C. Zehm.

result in the saving of fuel. Results of tests made at a brick plant in St. Louis, recently visited, show a decided saving in fuel and an improved product. At South Park, Kentucky, after preliminary burns in a type of kiln for burning hollow tile, the car superintendent was able to point out needed changes in construction and operation that should result in a decided saving of fuel and an improved product.

Ceramic Experiment Station, Columbus, Ohio

Oxidation of Ceramic Wares during Firing

It is planned in the investigation of the oxidation of ceramic wares during firing, to continue making measurements of the rate of evolution of H_2O, CO_2, SO_3, and SO_2 from clay bars (Lower Kittaning fire) in a combustion tube in a current of oxygen at various temperatures, atmospheres and typical clays. During the oxidation of "siderite" iron clays, siderite, magnetite and hematite are, at a certain stage of the burn, all present at the same time.

Georgia Clays and Bauxites

Washing tests of Georgia clays have been completed. Samples of bauxitic and refractory clays have been calcined to cone 13, ground to pass 10 mesh and mixed with 40 per cent raw clay. Samples of commercial size bricks have been completed by the dry process. When made up into a standard pottery body this clay showed none of the objectional specks common to unwashed Georgia clays and was a good color.

Dolomite Investigations

Slacking tests have been run by the Bureau of Mines on clay-dolomite, bauxite-dolomite bricks previously burned. Different dolomites are being investigated as to mechanical and chemical desirability. The highly crystalline ore has been found to crush more readily than the dense.

New Members Received during May

Associate

Allison, John H., 902 Oliver Bldg., Pittsburgh, Pa., Sales Engineer, E. J. Deckman Co.

Bowers, John, 1510 Brunswick Ave., Trenton, N. J., B. O. T. Mfg. Co.

Curry, Earl, Willoughby, Ohio, Student, Ohio State University.

Donnenwirth, Arthur L., 121 S. Spring St., Bucyrus, Ohio, Student, Ohio State University

Green, Thomas S., La Courneuve, Seine, France, Cie des Meules Norton

Kane, Edward, 1432 Riverside Drive, Trenton, N. J.

Kennedye, C. Benton, 2085 Railway Exchange Bldg., St. Louis, Mo., District Manager, Brown Instrument Co.

Parsons, F. C., Atlantic Terra Cotta Co., Tottenville, N. Y., Supt.

Roberts, Nathaniel J., Quakerstown, Pa, Gen. Mgr., Quakerstown Stove Works

Rose, Charles I., 3802 Castleman St., St. Louis, Mo., Student, University of Illinois

Schweiker, Malcolm A., 137 W. 25th St., New York City, Gen. Mgr., Empire Floor and Wall Tile Co., Inc.

Thorpe, Drew M., 1922 Oliver Bldg., Pittsburgh, Pa., District Manager, E. J. Lavino & Co.

Tokunaga, Zenshiro, 2 Chome, Yorikunachi, Osaka, Japan

Corporation

Livermore Fire Brick Works, 604 Mission St., San Francisco, Cal.

J. L. Mott Co., Trenton, N. J.

The National China Co., Salineville, Ohio
Robertson Art Tile Co., Box 848, Trenton, N. J.
St. Louis Terra Cotta Co., 5811 Manchester Ave., St. Louis, Mo.

Batter Up!

In personal memberships this month we have held our own—thirteen—(an unlucky number to stick at), but in Corporation memberships we have taken a sickening drop. Optimistic as ever, though, we have an encouraging point to bring out. Seven of the Associates and four of the Corporations came in during the last three days. We expect now to have a batting average of four a day for the next month.

Bowman 2nd and Hottinger head the batting list with two Corporation members each. Babcock, Burroughs, and Watts have two Associate members each, and Salisbury has added another to his list of Corporation members. Those who put the leather across the plate once are Christopher, Hursh, Ichijo, Klinefelter, Malm, Ogden, and Wells. This shows that some of our bush-league players are giving the old guard a chance to wonder whether they can hold their places on the team.

Here is a typical letter from a typical worker:—

"Mr. Ross C. Purdy, *Secretary*
American Ceramic Society
Lord Hall, Ohio State University
Columbus, Ohio

Dear Sir:—

Will you kindly send to Mr.———, Chemist and Metallurgist of———, a sample *Journal*, descriptive literature of the Society, and an application blank. He is interested in fire clay refractories and I would appreciate it if you would send him a *Journal* containing an article on this subject.

Yours fraternally,
(Signed)—————"

We have had a letter of this kind from the same man at least twice a month since he joined the Society about a year ago. Most of these "prospects" become members and boosters in their turn.

The Membership Committee are getting into their new uniforms. O. O. Bowman 2nd, the chairman, has a beautiful wind-up, the plate has been dusted off—now get into the game!

An Umpirical Correction

The score-card of the membership game, "Play Ball," reported in the May number, was slightly balled up and off its base, as it failed to give credit to Sam Geijsbeek for two more hits, making three in all and putting him in Class 2 of the pill-pounders. Having been properly cushioned, the umpire hastens to make this announcement, with due apologies.

Geographically Speaking

The geographical distribution of the *Journal* has been the subject of study lately, and the figures compiled are given below:—

Alabama	1	Connecticut	4	Florida	1
California	55	Delaware	2	Georgia	10
Colorado	12	District of Columbia	33	Idaho	1

Illinois	146	New Jersey	160	Washington	16
Indiana	47	New York	187	West Virginia	42
Iowa	17	New Mexico	1	Wisconsin	14
Kansas	7	North Carolina	5	Wyoming	1
Kentucky	13	North Dakota	2		
Louisiana	1	Ohio	319		
Maine	2	Oklahoma	3	Australia	8
Maryland	30	Oregon	8	Canada	38
Massachusetts	40	Pennsylvania	237	England	63
Michigan	37	Rhode Island	3	France	13
Minnesota	5	South Dakota	2	Philippines	1
Mississippi	1	Tennessee	11	Scotland	7
Missouri	78	Texas	8	Japan	74
Montana	2	Utah	4	Miscellaneous Foreign	69
Nebraska	1	Virginia	3		

Total 1845

As was to be expected, Ohio has the largest number of subscribers, with Pennsylvania as the runner-up. New York, New Jersey and Illinois are not far apart, but the rest of the states are not even on the same lap. Missourians have to be shown, of course, but surely seventy-eight is not adequate representation, and are there only four progressive ceramists in Connecticut?

Who's Where in the American Ceramic Society?

W. J. Bidleman has moved from Wellsville, Mo., to Denver, Colo., where his address is 12 Meade Apts., 200 Broadway.

H. D. Callahan of Columbus, Ohio, has taken a position with the National Fire Proofing Co. and is at present located at Port Murray, N. J.

George W. Cooper, publisher of "Glass Industry," has notified us of a change in the location of his office from 19 Liberty St. to 50 Church St., New York City.

S. F. Cox, of the Pittsburgh Plate Glass Co., has moved from Creighton, Pa., to 628 Haverhill St., Wilkinsburg, Pa.

E. E. Fisher, formerly of the Modern Glass Co., Toledo, Ohio, is now in the feldspar business at Hayesville, N. C.

R. D. T. Hollowell, secretary of the American Face Brick Association, may now be found at 130 North Wells St., Chicago, Ill., the new headquarters of the Association.

Lloyd Lamborn, editor of "Chemical Age," announces the removal of his office from East 28th Street to 381 Fourth Avenue, New York City.

Paul D. Merica, of the International Nickel Co., has changed his headquarters from Bayonne, N. J., to 67 Wall St., New York City.

Amos P. Potts, formerly with the Seguin Brick and Tile Co., at McQueeney, Texas, is now with the Clay Products Co., at Brazil, Ind.

G. R. Shelton, research fellow for the Corning Glass Works, has been transferred from the University of Illinois to the University of Saskatchewan, Saskatoon, Canada.

S. F. Walton has recently become a member of the firm of the Northern Refractories Co. at Ridgway, Pa., dealers in high grade crude and ground Pennsylvania fire clay.

Calendar of Conventions

American Association for the Advancement of Science—Salt Lake City, Utah, June 22–24, 1922

American Society for Testing Materials—Atlantic City, N. J., June 26–July 1, 1922, C. L. Warwick, Sec., 1315 Spruce St., Philadelphia, Pa.

International Union of Pure and Applied Chemistry—Lyons, France, June 27–30, 1922

National Bottle Manufacturers Association—July, 1922, C. R. Stevenson, Bus. Mgr., 120 Broadway, New York City

Annual Safety Congress of the National Safety Council—Detroit, Mich., August 28–September 1, 1922

American Chemical Society—Pittsburgh, Pa., Sept. 5–9, 1922, Charles L. Parsons, Sec., Washington, D. C.

Association of Iron and Steel Electrical Engineers—Cleveland, Ohio, September 11–15, 1922, John F. Kelly, Sec., Empire Bldg., Pittsburgh, Pa.

Eighth National Exposition of Chemical Industries—New York City, September 11–16, 1922

American Electrochemical Society—Montreal, Canada, September 21–23, 1922

National Association of Commercial Organization Secretaries—Chicago, Ill., October 23–25, 1922, John E. Northway, Sec., Hamilton, Ohio

National Exposition of Power and Mechanical Engineering—New York City, December 7–13, 1922

American Malleable Castings Association—January 10, 1923, Robt. E. Bolt, Sec., 1900 Euclid Bldg., Cleveland, Ohio

National Jewelers Board of Trade—New York City, January 18, 1923, F. C. Backus, Sec., 15 Maiden Lane, New York City

American Concrete Institute—February, 1923, Harvey Whipple, Sec., East Grand Boulevard at Moran, Detroit, Mich.

American Ceramic Society—Pittsburgh, Pa., February 12–17, 1923, Ross C. Purdy Sec., Columbus, Ohio

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Report of the Enamel Division

The fourth annual meeting of the Enamel Division of the American Ceramic Society was held at St. Louis, Mo., February 28 to March 3, in conjunction with the annual convention of the Society. There were 87 members of the Division present, a record attendance. Sixteen papers were read before the Division. These will appear in the *Journal of the American Ceramic Society* during the year. Editor Purdy has arranged for the publication of discussions by any member of the Division interested, and additional information in connection with the various papers will thus be brought out. All written discussions on the subjects of the papers will be welcomed by the Editor.

The following officers were elected for the present year:

Chairman—B. T. Sweely, Coonley Mfg. Co., Cicero, Ill.
Secretary—R. R. Danielson, Bureau of Standards, Washington, D. C.
Councilors—D. F. Riess, Vollrath Co., Sheboygan, Wis.
W. C. Lindemann, A. J. Lindemann & Hoverson Co., Milwaukee, Wis.
R. D. Landrum, Vitreous Enameling Co., Cleveland, Ohio
H. F. Staley, Metal & Thermit Corp., New York City

The following committees have been appointed for the year:

Standardization of Tests—E. P. Poste, *Chairman*, R. D. Cooke, H. N. Cox, L. J. Frost
Standardization of Products—D. F. Riess, *Chairman*, R. D. Cooke, C. A. Blackburn, B. T. Sweely

Membership—W. C. Lindemann, *Chairman*, C. M. Smoot, F. G. Jaeger, R. D. Landrum, E. E. Geisinger, H. N. Cox

Rules—J. B. Shaw, *Chairman*, R. D. Wells, B. A. Rice

Data—R. R. Danielson, *Chairman*, E. P. Poste, H. F. Staley, H. P. Reinecker

Research (*Sheet Iron and Steel*)—R. R. Danielson, *Chairman*, D. M. Buck, R. B. Dimmick, J. A. Aupperle, H. S. Marsh, Ernest Richardson, C. A. Blackburn, L. A. Adams

Research (*Cast Iron*)—R. R. Danielson, *Chairman*, W. C. Lindemann, H. R. Mills, M. E. Manson, E. P. Poste, B. B. Kahn

The various committees are now actively at work and there is every promise of the Enamel Division becoming increasingly important and valuable to those connected with the enameling industry.

A meeting of the Research (Cast Iron) Committee was held at Cleveland, Ohio, on May 11, with the entire membership of the Committee present. A comprehensive program of an investigation of cast iron for enameling purposes was drawn up at that time with particular reference to the blistering of enamels applied to cast iron. This investigation will be conducted in coöperation with the Enameled Metals Section of the Bureau of Standards, and it is hoped to interest actively all cast iron enamelers of the Enamel Division in the work through a questionnaire to be sent out by the Secretary at an early date.

The Research (Sheet Iron and Steel) Committee has planned an investigation of the warpage and buckling of iron and steel sheets in the enameled process. It is planned to conduct the preliminary studies at the Bureau of Standards, this to be followed by coöperative work in several of the enameling plants engaged in the enameling of flat sheets.

The Committee on Data has planned the preparation of an index of the enamel papers which have appeared in the *Transactions* and *Journals* of the Society. The index will probably include other information pertinent to the Division.

The By-Laws of the Division have been revised to conform with revisions in the Constitution of the Society and copies have been sent to the members of the Division for vote.

The Division now has a membership of 21 Corporation, 39 Active and 150 Associate Members.

American Ceramic Society Summer Excursion Meeting

Rochester, Montreal, Ottawa, Kingston, Toronto, Hamilton, Niagara Falls, Buffalo

August 13–19 inclusive

Inspection of Feldspar Mill—Enamel Plant—Glass Plant—Wall and Floor Tile Plant—Brick Plant—Hollow Ware Plants—Electric Porcelain and Abrasive Plant—and the famous Canadian Feldspar Mines at Verona.

A delightful trip by water from Rochester, N. Y., to Montreal, Quebec. The famous Thousand Islands. DAYLIGHT TRIP from Thousand Islands to Montreal. A never to-be-forgotten trip filled with beauty and thrills. Running all the rapids. **The Galops and the Rapids duPlat** are the first and least exciting, though they are bounded by wooded curves that make this stretch of the river one of incomparable wonder.

Long Sault Rapids next: The greatest of all the St. Lawrence; nine miles of seething water between cool green masses of wooded islands.

Coteau Rapids: Tortuous, winding in and out among seven miles of islands.

Cedar Rapids: the most beautiful of all.

Split Rock Rapids: Difficult to navigate.

Cascade Rapids: White crested and foaming.

Lachine Rapids: The last of the rapids, narrow, twisting, irregular.

Sounds exciting and it is!

The Schedule of Itinerary

Sunday—August 13th: Lv. Rochester, Boat, 10:45 P. M.

Monday—August 14th: Ar. Montreal, 6:45 P. M.

Tuesday—August 15th: Montreal.

Wednesday—August 16th: Lv. Montreal, 8:30 A. M., Ar. Ottawa, 11:30 A. M.

Thursday—August 17th: Lv. Ottawa, 10:40 A. M.; Ar. Verona, 2:34 P. M.; Lv. Verona, 6:35 P. M.; Ar. Kingston, 7:35 P. M.; Lv. Kingston, 10:30 P. M.

Friday—August 18th: Ar. Toronto, 7:30 A. M.

Saturday—August 19th: Lv. Toronto, 9:15 A. M.; Ar. Hamilton, 10:15 A. M.; Lv. Hamilton, 2:30 P. M.; Ar. Niagara Falls, 4:15 P. M.

Expense of the Entire Trip

	Fare	Lower	Upper	Seat	Total
Rochester to Montreal	$11.55	$2.50	......	....	$14.05
Montreal to Ottawa to Verona to Kingston	7.80	......	......	1.30	9.10
Kingston to Toronto	6.10	2.75	......	....	8.85
Toronto to Hamilton to Niagara Falls	2.90	......	......	1.20	4.10
					$36.10

Upper Berths 50c less than lower. Drawing Room four times the Lower Berth Rate. Daily additional expense $10.00 per day. Meals and Hotel per single person.

Estimated Maximum Total Expense $100.

IMPORTANT NOTICE

EXCURSION TO ENGLAND

Owing to industrial conditions here, as well as in England, the excursion to England has been postponed until the Summer of 1923.

COLLOQUIUM[1] ON FELDSPAR AND FELDSPAR DEPOSITS[2]

(This colloquium was led by Raymond B. Ladoo, mineral technologist of the U. S. Bureau of Mines. His preliminary report on this subject, as published in the *Bulletin*, issued by the Society February 20, was the basis of this colloquium.)

The outstanding features of the present feldspar industry as given by Mr. Ladoo are as follows:

(1) Many grinding companies do not own or control all or even a major part of their sources of crude material, but buy in job lots from many sources.

(2) There is a great need of more adequate engineering and chemical control over mines and mills.

(3) Out of date, inefficient methods and equipment for mining and grinding are in common use.

(4) Little or no coöperation exists between feldspar producers, but on the contrary many feldspar companies are exceedingly secretive. This tends toward (*a*) preservation of obsolete methods; (*b*) want of knowledge of the essential features of production, market requirements, and the relation between total milling and consuming capacities of the country; (*c*) inefficient and often mistaken trade practices; (*d*) unprofitable and even ruinous competition in dull periods.

(5) The small size of many feldspar deposits precludes maintenance of an efficient organization at each individual mine.

(6) Many of the best deposits of feldspar situated close to railroads are becoming depleted, which results in gradual lowering of grades, and increase in cost for better grades.

(7) There is a lack of exact knowledge of the ceramic properties and behavior of feldspar by some consumers, which results in (*a*) purchase of feldspar on the basis of price alone, thus encouraging low production costs at the expense of quality, and (*b*) inefficient and expensive crosshauling of both crude and ground feldspar.

(8) The grinding capacity of the country greatly exceeds the consuming capacity. There are more than 25 mills with a total capacity in excess of 300,000 tons per year, for a normal consumption of not more than 150,000 tons per year.

(9) There is a lack of uniform tests, specifications and standards of quality and fineness for different uses; and lack of standard definitions of grades.

Suggestions given by Mr. Ladoo to improve the situation are as follows:

(1) Gradual replacement of all of the present mills by a small number

[1] NOTE:—Article X (10) *Constitution of the American Ceramic Society.*

The Society is not, as a body, responsible for the statement of facts or opinions expressed by individuals in its publications.

[2] White Wares Division, Annual Convention, St. Louis, March 1, 1922.

of new grinding mills designed by competent engineers and equipped with the latest and most efficient machinery.

(2) Ownership or control of sufficient deposits of high-grade feldspar by the grinding companies to supply their entire requirements.

(3) Setting up of standard grades and specifications for feldspar for all uses.

(4) Instituting of centralized chemical and engineering control over all mining and milling operations, so that an absolute check on quality may be had at all times.

(5) Close coöperation among producers and between producers and consumers in order to promote greater knowledge and confidence and a more intelligent production and utilization of feldspar.

Discussion on Feldspar

MR. LADOO:—This report was made at the request of a group of potters who came to the Bureau of Mines and asked that a thorough investigation of the feldspar industry be made. I spent nearly a year collecting the information that went into the report, and before the report was issued, I submitted it to eight or ten different people representing different branches for criticism, and all of the criticism received was incorporated into this paper, so that this paper not only represents my opinion, but the opinion obtained from various sources.

MR. SLADEK:—Did Mr. Ladoo inquire into means for increasing purity of the ground feldspar?

MR. LADOO:—I have discussed that question in reference to iron. I do not know whether a process can be worked out to eliminate iron. It has *not* as yet been done. It is a subject which ought to be investigated further.

MR. A. A. KLEIN:—I see no reason why there should not be some method devised to do away with these iron particles.

MR. SPURRIER:—The question of separating iron from feldspar is not alone a question of separating iron by magnets. You may thus purify the feldspar as much as you can, getting all the iron out that is practical, and some will still be left. I have seen a magnetic separator used by potters with both good and poor results. There is one thing to be remembered, no matter how well you make the separation, nothing will ever give you absolutely iron-free materials when using the magnetic separator alone. You are almost certain to get free iron in your material simply from the mechanical handling. If your maintenance gang is working in proximity, it is not certain they will not let some iron drop into what you are handling. In any case a potter cannot be excused for not using some sort of separator. I think the best place for the magnetic separator is in the slip, but even

here I do not think you will ever get complete removal of the iron. To do it most effectively, your layout has got to be very big, and that involves a very big item of expense.

Mr. Ladoo:—I think an improvement could be made in some mills by putting in a magnetic separator between the coarse crusher and the fine grinder, to remove iron which comes from the crusher plates, and thus do away with some of the iron which is bound to get into the product from handling. I think that can be done very well in some cases at least. In some processes magnetic materials are removed by magnets. I have heard in the past year of two or three installations of a process that would remove a considerable amount of such materials, but I very much doubt if even that process can economically give a pure enough product.

Mr. Jos. P. Rodgers:—I have been in the business a number of years. About a year ago, a large manufacturer made a number of tests producing a sample that looked pretty good. I ordered a carload and ground one half of it through a Hardinge mill; the other half through an out-of-date apparatus, and then had the two products analyzed. In about fifty analyses during the past year this quarry has shown an iron content averaging .18%. In the tests that we made of the feldspar after grinding from two different forms of apparatus, there was not a difference of 0.01% between the two feldspars. We had three analyses made of the Hardinge mill grind, and three analyses made of the granite chaser grind.

I wish to read a discussion of Mr. Ladoo's report which I have written.

Mr. Ladoo has undoubtedly presented many points of merit, yet from my own viewpoint, I am unable to see that we have been given anything that will materially assist us to give the manufacturer of Ceramic products a better material at a better price. I am not in a position to speak for other millers, and can only judge from what we are doing and in the light of my own experience, which has extended over nearly 30 years. It seems to me that Mr. Ladoo has been unduly severe in his criticism of our end of the game.

The condition of the feldspar business in 1920 was a temporary one, due entirely to the fact that 90% of the business men of the country lost control of their labor, lost their heads and made a wild plunge for profits. The feldspar miller was not alone in this respect, but his capacity for doing damage was greater, and for that reason, he is better remembered.

So far as the ownership of mines is concerned, I was under the impression that most of the old line millers, either owned or controlled considerable deposits. I know there are a number of millers who do not control mines, but these people are doing business because of the philanthropy of the feldspar consumers and, having no responsibility, dump the onus of their errors on other millers who have sins enough of their own.

So far as engineering and chemical control is concerned, we are doing

what Mr. Ladoo says we ought to do, and then some. Our Company uses 150 gallons of kerosene each month to operate a testing furnace. We have a complete set of test screens and use them daily. We employ a reputable chemist to keep us posted on the composition of our crude materials, and the man in question had two years practical experience in work of our character before he began to do our analytical work. It is true, as Mr. Ladoo says, that we do not do this work at our mine. We do it in a chemical laboratory where naturally, one would expect it to be done.

As to the series of paragraphs on inefficiency at mine and mill, I think you will grant that what is efficient and what is not, is largely a matter of opinion, yet I cannot help but feel that Mr. Ladoo has picked out for his "horrible examples" one or two radical instances which could hardly be considered as typical of the industry. Surely the concern which required six handlings at its mill is not one of the country's large millers. At our principal deposit the feldspar is mined in an underground shaft, and when it is broken it is loaded into a skip or mine car, hauled out of the mine and dumped on to a grizzly where it is sorted either for a truck to the railroad or a cart to the refuse dump. When the car reaches the mill, the feldspar is forked into crude feldspar bins and from there it is wheeled either to a large crusher or to a chaser mill.

We are not dependent entirely upon what Mr. Ladoo terms an out-of-date style of mill, nor have we adopted, I am glad to say, all of the innovations shown on his flow sheets. In one department we have an old type chaser mill and a finish mill and in another we have the large and small crushers, the conical mill and finish mill. The last named operations are far more efficient than the chaser mill, but some of the largest users in the country will not buy feldspar that is handled through a rock crusher, and the conical mill cannot be adequately fed without one. As I have said, we have them both; you "pay your money and take your choice."

A few weeks ago a competitor asked my advice on the proposition of installing a rotary dryer such as Mr. Ladoo suggests. He had been quoted \$2800 for the dryer, and the motor, shafting and cost of installation would add \$700 more. I happened to know that he could cover the floors of his crude feldspar sheds with a steam pipe pan and install a boiler to produce his steam all for \$900 and the cost of operating the outfit would be about the same as the operating cost of a rotary dryer, consequently, we could not see the advisability of that part of Mr. Ladoo's plan.

In another place the capacity of the Improved Feldspar mill is placed at 4 tons per hour. The most feldspar we are able to force into a 22-inch mill is 4500 pounds per hour.

The 30-inch mill has an advertised capacity of 10% greater than the 22-inch mill. I submit that it would be a difficult problem to take more out of the mill than you can put into it.

One of our competitors recently bought a much advertised air separator. It is said that he bound the selling company to secrecy before he placed his order, and that he has whispered to consumers the supposed fact that because of this separator, "all your feldspar troubles are ended now, henceforth and forever." Various forms of air separators have been sneaked into feldspar mills to my knowledge for the last twenty-five years in the hope that something practical might be developed. One of the principal impurities in feldspars is mica, a much lighter substance than feldspar, and the air separators gather up all the light weight mica with the finest grinding of feldspar, which we want for our highest grades, with the result that all the mica becomes segregated in the fine feldspar.

Another competitor, an older miller, probably knowing the futility of air separation, experimented recently with the screening process but the abrasiveness of feldspar caused his screens to wear out faster than he could put them into the machine. It is said that the experiment showed that the cost of this kind of treatment would add more than $1.00 per ton to the price of feldspar, and the miller would not be getting anything except the doubtful value of advertising a project that did not work out to practical advantage.

And now a word for the intermittent mill, the type for which it has been said "that fine grinding under these conditions is like trying to pulverize sea sand by striking the beach with a hammer." That is a very pretty simile. I regret that practical experience knocks it into a cocked hat.

The finest grinding of feldspar in this country today and for the past twenty years is required by the Orford Soap Co., makers of Bon Ami. Their specification demands a test by which 16 ounces of feldspar is stirred into a couple of gallons of water and then run over a 200 mesh brass lawn. In these 16 ounces there are 7000 grains. If the residue on the screen when dried weighs in excess of 5 grains (about $^1/_{12}$ of 1%) the material is not acceptable. I think you will admit that this is a severe test. Fineness of that kind cannot be obtained in a continuous mill. No form of air separation has yet been devised that will give it to you in quantity sufficient to make it commercially valuable. How then do we get it? Why, by "taking our hammer down to the sea shore" and grinding in an intermittent mill.

There is plenty of feldspar to be had from experienced millers, which in any kind of normal times will be carefully selected, up to the price you are willing to pay for it, and *down* to any price the miller has to take for it. Do not spend all your time reforming the miller. Take a little of the medicine yourselves, and remember that it may be well to limit your purchasing agent to feldspars that have borne the tests and the practical examination of ceramic engineers who know their business.

Mr. Ladoo:—Mr. J. P. Rodgers has prepared a serious indictment. I talked with Mr. Rodgers quite a while on the train, and I am convinced

that his idea of the feldspar industry and mine are not so far apart as his criticism seemed to imply. He spoke of the condition during the past few years. That is absolutely correct, and I realize that practically no effort to improve on the milling methods has been made. During the past few years, as a matter of fact, improvement has been at a standstill. That horrible example which he mentions, I believe I am right in saying, refers to one of the oldest and one of the largest feldspar grinding companies in the country. It is also true, as he says, that the grinding efficiency has been increased by drying. If the plant is run by steam, it might be much cheaper to use your waste steam to run your drier instead of the method suggested by Mr. Rogers, but if your mill is electrically driven it might be cheaper to put in some form of a rotary drier. The statement of capacity of the mill is actual and not estimated. Mr. Rodgers stated he gets 4500 pounds; that is two and one-fourth tons—is that with a drier or without?

Mr. Rodgers:—That is working on the dry material, but not material that has been dried artificially.

Mr. Ladoo:—I believe the grinding capacity when grinding some materials can be increased by drying and the capacity of the so-called ideal material can be enhanced by use of the air separator which takes out the fine material. This would increase the capacity of the mill making it possible to get four tons through the largest type of Hardinge mill. With reference to mica, that is a proposition that must be worked out a little further before determining whether or not air separators can be used on all types of feldspar. But I cannot see how the question of mica is involved in the use of air separation, because there appears today to be but two means of getting out mica. First, the mine run may be selected to exclude all the mica the feldspar contains. The only alternative seems to be by screening. Screening, I will have to admit, has not been very successful. In fact, screens have been thrown out of feldspar mills as being unsatisfactory for the reason that the screen wears rapidly, mica gets into the openings, and the screens blind. If the mica cannot be removed by hand sorting or screening, it must stay in. If the mica stays in, I do not see that an air separator can either improve or injure the product. I do not believe that any manufacturer of air separating equipment would claim he could get out the mica. I have never seen one that could. Air separation, as used today, is a sizing, not a purifying, process. I do not think the questions of mica and air are at all connected.

Mr. Smith:—We have two mills. In one of them we use a large crusher. It is an 8 x 10 crusher. So far as our practical experience has been, I think there is almost no difference in analysis between the product of one mill and that of the other with the manganese steel jaws.

Mr. Ladoo:—That to me would seem absolutely correct. I cannot see how the crusher with the manganese steel jaws can add any more iron

than would be added by sledging and the various methods of handling. You would probably add just as much iron or more iron by sledging than by using the crusher. I think some standard should be obtained on that point.

There is one point which I would like to emphasize in the defense of the feldspar millers, and that is the question of price. The price of ground feldspar has not gotten back to pre-war prices and it never should unless conditions change radically. I hope it will not under present conditions because it would mean bankruptcy for many feldspar companies.

I think the parties that should be most interested in obtaining adequate supplies of uniform crude material should certainly be willing to pay a price which will give the feldspar millers a seasonable profit. The history of feldspar mining in this country and Canada shows that the industry in the early days was very crude. They took the finest feldspar closest to the railroad, discarded all the rest, threw it away on dumps, and moved on. Now they must either use the lower grade of materials near the railroads or haul the material which is located further away from the railroads. The costs must be higher if feldspar must be hauled long distances. I can see no return to the low prices prevailing before the war.

Referring back to the question of iron in the feldspar, what percentage of iron aside from specks of metallic iron should be allowed in feldspar? What amount could be tolerated in high-grade feldspar?

MR. SPURRIER:—I am afraid that is a proposition that cannot be answered. It would be out of the question to estimate that. I would not want to say how much; we should have a standard.

MR. LADOO:—I think it is very important for the purchaser and consumer; (they go hand in hand) that some form of standard should be settled upon. If the potters try to set up absolute standards, the feldspar millers might find them impossible to meet. If the millers attempt to set up standards, the potters might take issue. I think they both should get together and work out standards mutually acceptable.

Discussions Received since St. Louis Meeting

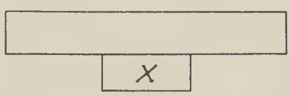
BY R. H. WAINFORD:—As our company is one of the oldest and largest feldspar concerns (capacity 1600 tons a month) it will not, we hope, be out of place if we take up the cudgels in defense of ourselves, and also of our mining and grinding friends, as we feel that the statements made by Mr. Ladoo are very sweeping and while there may be instances that give color to all of his assertions, we hope and feel that they do not apply to our industry as a whole.

This paper will, no doubt, be read by the pottery manufacturers, who urged the investigation, with as much interest as the feldspar producers

themselves, the investigated parties, as consideration of this subject has been extended away beyond our fields of endeavor and right into the very core of the ceramic industry itself of which the feldspar producers are only a minor incident.

It seems to me that the mining experts of the Bureau of Mines in this investigation have neglected the vital parts of the feldspar industry, *viz.*, the prospecting and getting of feldspar. Prospecting for and quarrying of feldspar is many times more vital to us than the grinding which is a mechanical process.

The paper refers to other industries that have gained by the adoption of scientific and automatic processes, while the ceramic industry has contented itself with old fashioned ways; engineers unacquainted with pottery plants very often make this analogy, the pottery industry, however, is totally unrelated to any others. Again let me say, I am entirely out of agreement with Mr. Ladoo on this question of out of dateness compared with the steel trades or any other and the pottery trades. There has been just as great advances in every sense that need to be applied in the industry now under the magnifier. Mr. Ladoo has shown two flow plans; the first being a grossly exaggerated case and the other ideal. They remind me of a black board sketch made at the Philadelphia meeting of this Society. The sketch looked like the one given here:



The little chap on the side was explained to be the combustion chamber, that when properly designed would end, for all time, kiln-firing troubles that have been troubling the potters for the past hundreds of years, and give money in the pocket besides. I have marked this wonderworker with the letter (x) as this is the algebraic sign many of the members have been looking for since that time.

I will now endeavour to reply to Mr. Ladoo's "outstanding features" numbered 1 to 9 on the first page of his paper. These might have been styled "charges."

(1) In regard to the statement that many grinding companies do not own or control their supply, I would say that for our Cathance, Me., mill, we have obtained feldspar from our own quarry for over 50 years. For our Trenton Mill, we obtain feldspar from a New England State, and before obtaining this quarry we investigated a score of deposits in this country and Canada, making a large number of analyses and physical tests of samples from prospectors whose deposits were for sale. So we do not buy in job lots.

(2) The engineering control of our business is unfortunately in the

inadequate hands of myself, a mechanical engineer, so titled by the British Institution of Mechanical Engineers. The quality of product control has been in efficient and trained hands. One of our mills and the deposits attached to it were superintended for about forty years by a gentleman whose name was known to all the whiteware manufacturers of the old school in this country. Unfortunately he has now passed away. He was always inquired of, with not only esteem but affection, and our product was as much known by his name as ours. Our present manager and superintendent, trained at Harvard and Massachusetts Inst. of Tech., is this gentleman's son, and was his assistant for 16 years before taking over the official duties. Our mill at Trenton and its deposits of feldspar are in the main looked after by one of the products of Prof. Brown of Rutgers. The treasurer of our company who has been connected with the manufacture of whiteware pottery all his life also interests himself in both plants. He professes to be a "practical potter" and only hopes that he gets somewhere on the outskirts of this designation; if he reaches that, he wishes me to state that he desires no better compliment.

(3) Regarding the out-of-date and obsolete inefficient methods of grinding; our mill in Maine was first operated by water and so was placed where there was a head of water. It was fortunately also at the head of tide water, where, before railroads were operated, the ground product was bagged and sent down the river in boats to its destination. Years passed along, the railroad came within a quarter of a mile of the mill and the product was then loaded on the railroad. As years passed, the forests were cut and water became more and more intermittent; then we put in a steam plant and at a later period an electric plant to keep in touch with modern witchcraftry. We, however, still run this mill by water power, when the head of water is available, which it is for about three months in the year.

Our mill at Trenton, was erected last year. We concluded after a great deal of thought to continue to use periodic cylinders and chaser mills. There may be other methods which many would think are more efficient and produce a better product, but we have produced a definite product for many years, hence our choice of machinery is not without experience or knowledge of what is the best. This plant is electrically equipped and provided with suitable apparatus to protect the health of our employees and has such devices for the manipulation of the products that seemed desirable, always bearing in mind as we had to do, that what our customers want is not how automatically we can run our mill, but the proper kind of feldspar which they use as only one of the ingredients in the manufacture of their products.

(4) We do not know what is meant by lack of coöperation among feldspar producers. They are not secretive. When Mr. Ladoo visited us

at Trenton, he was shown around our plant, which was then almost completed for working and was given a letter of introduction to our manager in Maine asking that he be shown every civility and given such information as would be useful for his report. He was invited back to Trenton to see the mill in operation which he promised to do, but did not return. Our fellow feldspar producers have been invited and some have visited our mill; a number of our customers have also done the same. From this it will be seen that we are not secretive in our methods; at the same time, we hardly see why a manufacturer must be taunted if he refuses to throw his plant open for public inspection.

(5) This is probably so.

(6) We presume that deposits of feldspar near a railroad that are continuously worked will get depleted, for what is taken out can never be replaced. If any one knows of a good deposit of feldspar near a railroad, we hope that he will not be secretive, but show a broad spirit and put us in touch with this desirable spot.

(7) We are going to leave it to our manufacturing friends to either defend themselves or excuse their shortcomings as pointed out in this paragraph.

(8) We think that more than half the capacity of grinding mills is taken up in grinding flint, cornwall stone, french flints, etc. We may be charged with wasteful over-production in building our new mill at Trenton, but in partial explanation of this we desire to state that twice our mill at Cathance, Me., burned down, and we were put out of business for long periods. We built this mill to protect ourselves against a recurrence of this fate. We can now carry greater stocks of finished material and fill orders in rush times.

(9) We regret that Mr. Ladoo has made this statement without being more explicit. Of course we do not intrude in the manufacturing operations of our friends and can only answer for ourselves, though we see no reason why they should not have some glimmering of intelligence in the preparation of their materials.

We have always had tests made for uniformity of our products and a standard of grinding. This is looked upon as being one of the fundamentals that are essential to a product like ours and which the potters who buy from us naturally expect to get.

By Harlowe Hardinge:—Mr. R. H. Wainford has made a very comprehensive discussion of Mr. Ladoo's article on the grinding of feldspar and there is no denying that many of his points are well taken, although I do believe that he has misunderstood the intent of some of Mr. Ladoo's recommendations.

Mr. Ladoo's reference to the adaptation of a process employed by one industry to another, in my opinion had reference to methods of grinding in the mining practice as compared with the ceramic industry, for in the treatment of ores, fine grinding plays a very important part in the whole process, and as a result, as much energy is exerted in solving this problem as in all the rest of the processes put together. It is here where the costs are usually the highest.

The mining industry has reached a stage where the saving of a few cents per ton of ore ground means a great deal, and in some cases spells the success or failure of the entire project. Literally, hundreds of methods of grinding have been tried out in this industry and only four or five systems have survived, all of which are continuous in operation. These systems involve wet grinding but the same condition holds true for fine dry grinding as has been demonstrated in many cases on record.

The present method of grinding feldspar by the intermittent process, usually with chaser mills or batch tube mills, is still profitable. No one can deny this point when we consider that in grinding in this manner the established producers are making money, for so long as this method is generally employed in the ceramic industry, those producers will continue to profit.

What Mr. Ladoo brings out is that the better known producers may be superseded by new companies who "take a chance" on installing a continuous system and are able to produce just as satisfactory a product for about half the cost. The well-established companies will not feel this competition until there are enough installations of the new system which are able to secure a satisfactory grade of feldspar and sell their product considerably below that which the older companies could afford, or unless these older companies fall in line and cut their production costs to meet the "young competitor."

There are many "ifs" to this argument, it is true, but there are enough facts which have shown a disinterested investigator like Mr. Ladoo what will come to pass.

Mr. Ladoo certainly laid himself open to attack when he recommended changing the milling system to such a radical degree, but it stands to reason that unless he had had ample proof that such changes had effected the economies claimed, he would never have dared present such radical recommendations.

It was intimated that Mr. Ladoo showed partiality to a particular system and advocated certain types of apparatus. Why shouldn't he if by so doing a benefit to the producer would result? The benefit derived by the manufacturers of the machinery involved in this plan is negligible compared with that accruing to the producer through years of operation.

By R. F. Segsworth:—Mr. Ladoo's paper on conditions in the feldspar industry impressed me both by the soundness of the theories set out and by the fact that the findings given as to conditions in the industry correspond closely with the results of our own prior investigations. Mr. Wainford's reply thereto has left the above impression unaltered.

We leave to Mr. Ladoo the replying to the criticism of the general scope of his inquiry, the form of his report, the question of whether or not his suggestions have been only destructive and not constructive, and the possibility of submitting further evidence in support of his assertions. Suffice it to say in passing that the improvements suggested do not appear to be in use by all companies, and that thirty-five or more years' experience is no answer to Mr. Ladoo's criticisms.

The discussion naturally falls under two heads: (A) Mills and consumers. (B) Mines and producers.

(A) With the first of these, we, in Canada, are but little concerned, owing to the almost entire absence of any grinding mills. At present there is in operation only one small mill. In view of the immense quantities and high grade of feldspar still to be mined in Ontario, the question of establishing mills in Ontario should be of interest to American grinders and consumers. The following figures show the production of crude feldspar in Canada, and in reading these it should be remembered that the Richardson mine at Verona, Ont., one of the largest producers of high grade feldspar on the American continent, has been shut down for the past four years, but is being re-opened within the next three months.

Feldspar Sold (Tons)

1911	1912	1913	1914	1915	1916	1917	1918	1919	1920
17724	13733	15935	18060	15455	19488	19462	18782	15955	32000

Up to the present, Canada has exported practically all its crude feldspar to the United States and imported from them nearly all its annual consumption of ground feldspar. At least 95% of the production of Canadian feldspar has come from the County of Frontenac in Ontario and the County of Ottawa in Quebec, and 90% of the total Canadian production has come from the Verona district in the County of Frontenac, near Kingston, Ontario. Recently deposits in the Buckingham district in the County of Labelle, Quebec have been opened which indicate the presence of a considerable quantity of feldspar of good quality. In 1900 the Verona district produced 4000 tons; in 1920 it produced 32000 tons. With improved transportation facilities, and the consequent reopening of the largest quarry in the district, the next year should see this production practically doubled—a field well worthy of the consideration of the American grinders and consumers.

(B) Mines and Producers. The conclusion to which Mr. Ladoo comes

in this connection is that the great need of the industry at present is a continuous production of high grade feldspar of a uniform quality. To this, Mr. Wainford's only answer is a challenge: "If any gentleman knows of a good deposit of feldspar near a railroad, we hope he will not be secretive, but show a broad spirit and put us in touch with this desirable spot." This challenge we accept.

(1) Quantity. We have referred already to the quantity of feldspar available in the Verona district. Perhaps it should be added that competent engineers have estimated that the Richardson quarry contains at least 300,000 tons of high grade feldspar; the same authorities believe that much greater tonnage is possible but this tonnage they consider certain. Anticipating the improvements now being made in transportation facilities, some 4000 tons of feldspar of a uniform grade are now ready for shipment.

(2) Transportation. There are a number of properties in this district only a few of which have been operated. None of them have been on a railroad and this has held back greatly their development, as the bush road has been possible only during a few months of the year. However, this drawback is now being completely removed as a means of transportation will be completed as soon as the frost is out of the ground, whereby shipments can be made at all seasons of the year. With the completion this spring of these works, it is expected that all quarries in the district will be operating at full capacity.

(3) Quality. The analysis given in the Bulletins on Feldspar and records at Washington, London, Ottawa and Toronto earmark the feldspars in the Verona district, Ontario, as being of high grade and in spite of the disadvantage of lack of transportation facilities they have always been able to get and keep a fair share of the high grade demand in the United States.

Bulletin No. 420 by Edson S. Bastin, issued by the United States Geological Survey is the most authoritative and comprehensive treatise on the feldspar situation in the United States. Under Grade and Prices, page 21, Bastin says: "Most dealers recognize three grades of commercial feldspar: No. 1, No. 2 (sometimes called Standard), and No. 3. No. 1 is carefully selected, free from iron bearing minerals, largely free from muscovite and contains little or no quartz, usually less than 5%. Analysis 6 of the table on page 9 shows the character of material of this grade. On the same page Bastin gives a list of prices for crude and ground feldspar—crude Canadian feldspar is quoted at $0.50 a ton higher and the ground Canadian feldspar at $1.00 per ton higher than any other grade. In all publications on feldspar the Canadian feldspars are given as examples of typical high grade, hard, potash feldspars.

By H. Spurrier:—In considering the question of feldspar it is obvious that the rock should be suitably free from objectionable minerals such as excess silica, mica, garnet, etc. This being the case, the question resolves itself into what happens to the feldspar during (1) grinding and milling; (2) transportation; (3) its sojourn in the potter's bins; (4) its being made into slip.

During all these experiences the feldspar is exposed to liability of contamination with free metallic iron or iron oxide. Contamination with free metallic iron or iron oxide is far more objectionable than an equal amount of iron existing in a more complex state of combination.

The following data relative to the amount of free and combined iron in potter's materials may be of interest.

The total iron content of a well-known ground feldspar showed on analyses, made ten months apart, 0.53% and 0.50% calculated as Fe_2O_3 and nine months later 0.45% Fe_2O_3.

The same feldspar showed on a careful magnetic separation 0.0016% metallic iron. A widely used domestic kaolin showed on two analyses made eleven months apart 0.80% and 0.68% of iron oxide. A careful magnet separation showed metallic iron 0.0004%.

Two samples of the finest white Canadian orthoclase feldspar showed 0.26 and 0.18% Fe_2O_3. These specimens were of extraordinary clearness, a fine hand specimen of two inches thickness being distinctly translucent. In preparing these samples for analysis they did not come in contact with iron at any time.

The following survey of the metallic iron content of raw materials, and dust made for dust-press practice from these materials may be of interest.

Feldspar taken from bin gave metallic iron 0.0016%. Flint taken from bin gave metallic iron not weighable. Standard mix made in porcelain mill and not coming in contact with any iron—0.00036%. Commercial slip coming from blunger before reaching electro-magnets—0.00129%. Dust from dust house—0.00193%.

An examination of dust collected in the immediate neighborhood of a crusher used in preparing dust showed an iron content of 0.011%. The iron content in this dust was not of the minutely fine character formerly noted, but appeared to suggest hack saw dust.

While the above facts may not be entirely pertinent to a discussion on feldspar, they are nevertheless, not entirely irrelevant, and would seem to indicate that potters need to "clean house."

As far as my own experience goes it seems that the crux of the situation lies in the selection of the proper grade of feldspar before crushing and grinding, as there seems little to fear from grinding and milling as practiced by reputable millers. Surely potters have no complaint to make of a feldspar that shows 0.0016% of metallic iron and this iron of a great degree of fineness.

By N. B. Davis:—Perhaps Mr. Ladoo has been carried beyond practical bounds in his endeavor to describe the conditions in the U. S. Feldspar Industry, but he has, nevertheless, succeeded in stirring up considerable interest that should eventually mark a period of advance.

During the past two years 3 or 4 new plants for grinding feldspar have been built in the United States using continuous and intermittent types of grinding equipment. There are two different systems of continuous mills—one using screen separation, and the other air separation, in sizing the final product.

It would be of considerable benefit to the industry as a whole if a study of results obtained could be undertaken and the data presented to the Society.

It is difficult to understand why advances should not be made in the milling of feldspar when all other industries turning out fine products have recorded improvements.

It is true that in general the milling costs of feldspar are too high, mainly because of the limited grinding capacity of the individual mills.

The problem of grading feldspar appears to have received the least attention in the original paper or in the subsequent discussions. From the standpoint of straight feldspar there are no commercially pure potash or soda silicates, but there are innumerable mixtures of the two, due to natural intergrowths and the material on the market shows this considerable variation. Products that are not feldspars but mixtures of quartz and feldspar with the latter predominating, are referred to by some producers as No. 1, while other producers rightly term feldspars without impurities, No. 1.

Would it not be better to have standards arranged for various products, and in this way aid the potter in looking for his sources of supply?

I am sure the Canadian producers are not at all secretive, and are only too glad to have visitors call on them. Speaking for our own interests, I might say that we would be very glad to have anyone interested spend a day with us at our quarries.

Prior to 1921 a number of grinders operating their own quarries shipped material that they would not accept from outside producers, and as a consequence, when the call came for a greater production, particularly during 1920, the whole grade of the output was lowered. Then came the complaints of the potters.

Mr. Ladoo was quite right in saying that eventually the quality of the material supplied would depend on the price allowed by the potters, so that in reality the ultimate consumer controls the quality.

By Edward Schramm:—Mr. Ladoo's very interesting paper deals primarily with feldspar milling problems. It may not be out of place to

present a few observations on feldspar from the point of view of the manufacturer of vitreous ware who is interested chiefly in quality.

The chemical requirements are high potash, low lime, low iron, and constancy of composition. A product high in free silica produced by the grinding of pegmatites or "graphic granite" like the Maine product is satisfactory, provided iron bearing impurities are low. However, the percentage of free silica in a feldspar of this type is likely to vary from time to time. Ordinarily these variations are not serious in a body composition, but for use in the glaze it has been found desirable to make a careful analysis and to adjust the feldspar contents so as to hold the SiO_2 proportion constant. Analyses are not required frequently if a carload shipment is set aside for use in the glaze only.

The determination of alkalis is frequently regarded as a stumbling block in the analysis of feldspar. However, with a little practice this determination can be made with great accuracy. Two critical points are the fusion and the separation of potash and soda. In the former, as shown by Hillebrand, the crucible should be heated to a high temperature after the initial slow heating to insure complete decomposition. The separation of potash and soda as perchlorates is very accurate if we use 97–98% alcohol which can be prepared by distillation of the 95% product over lime.

The production of a high grade feldspar depends on the success of the prospector in locating workable deposits with a high percentage of practically pure rock. We know of no commercially satisfactory method of eliminating such impurities as biotite, tourmaline, garnet, pyrite, hornblende, and surface iron, which introduce dark specks and impair the color of the fused feldspar. With regard to iron introduced in milling, we confess to being among those with a prejudice against jaw crushers because of the rubbing tendency in these machines. Chemical analysis of the product is not a sufficiently sensitive means of detecting this contamination. A few specks of iron sufficient to ruin the appearance of a fine china body, would hardly be found by the analyst. The only valid test is the comparative appearance of the buttons fired under identical conditions.

The fire test is conveniently made by placing a 50-gram sample in a heavy biscuit egg cup covered by a small butter plate and firing in the biscuit kiln. The purpose of this test is to judge cleanness and color. The degree of fusion of the button is not to be relied upon as an indication of fluxing power of the feldspar owing to the action of quartz in lowering the fusion point and to the increase in fusion point with increasing proportion of potash.

The fineness of grinding is a matter of great importance. The common use of metal testing screens of from 150 to 200 mesh gives little information to the consumer since such screens are not of the right order of fineness. The ideal test would be by elutriation or an analogous method, but this

scarcely appears feasible for routine work. The use of finer sieves gives a fair measure of the degree of coarseness. We use for the purpose either a XX16 silk lawn or a 250 mesh metal screen. The rejection on the 250 mesh metal multiplied by 1.4 will come very near the rejection on the XX16 silk. The particular standard rejection demanded will, of course, vary greatly with differences in manufacturing conditions. Silk lawns show considerable variations and the use of the metal screen is, therefore, preferable, even though the metal screens finer than 200 mesh are not guaranteed by the manufacturers as to uniformity of opening. In any case the material should be washed through the screen in slip form. The dry test is apt to mislead especially if the material is in a damp condition. This is particularly true of feldspar which has a greater tendency to matt than other materials.

By R. C. Purdy:—Mr. Ladoo described tests which millers of feldspar and the users of feldspar should make to obtain information regarding quality variation in constitution and accidental impurities. These have been touched upon by others in the discussions. I will here discuss only the chemical test.

A feldspar deposit that is worth working for A–1 feldspar can be quarried with a profitable output of clean mixture of feldspar and quartz, the feldspar portion of which will run constant in composition over quite a large portion of the quarry and a considerable period of time of milling. Records of shipments for month after month from three different quarries have shown that the composition of the feldspar portion of the material remained constant. The only variation was in the proportion of feldspar to quartz.

This having proven to be the case it was plain that it was not necessary to analyze the shipments for any thing other than SiO_2. Having determined by the hydrofluoric-sulphuric acid treatment the total SiO_2 in the sample, it is clear that the remainder consisted of the RO and Al_2O_3 of the feldspar. The SiO_2 belonging to this amount of RO and Al_2O_3 being known, it is readily figured, and this subtracted from the total SiO_2 gives the amount of quartz in the sample.

It is advisable for both the miller and the user to make complete analysis of the feldspar at stated intervals or whenever there is suspicion that the character of the feldspar mineral in the sample has changed. In my experience such a complete analysis was not necessary more than once in six months at the most and generally not more often than once in a year.

There is little to be learned from the difficult determination of the alkalis and alumina which is not disclosed by the easily accomplished and sufficiently accurate hydrofluoric determination of the total silica. For a routine test this determination is recommended because of its speed

and its closer approximation to accuracy than the determination of the alkalis or alumina by most of the routine chemists.

This simple test in connection with a petrographic determination will give more real information than will a total ultimate analysis, and the conclusions will be based on actual observations, there being no need for assumptions such as must be made when the mineral constitution of the sample is figured from the ultimate analysis.

By H. Spurrier:—Recently Mr. Schramm of the Onondaga Pottery asked me how I determined very small quantities of metallic iron in clays, feldspar, etc. After reading the method used he suggested that I forward it as a contribution to the discussion on feldspar.

Two and a half kilos of the material (feldspar, clay or flint), are well stirred up with water in a large tin lined or white enameled pan having wide flaring sides, as much like a miner's pan as possible.

Any lumps should be broken up and thorough admixture ensured, allowed to settle a few moments, and then any supernatant liquid together with a little of the solid material is poured off. This is repeated till the bulk of the solids has been reduced to about five hundred grams.

The procedure from now on is precisely that of the miner in "panning" gold. The contents of the pan are diluted with water, the pan being held at such an inclination over a sink that the water just comes to the edge. By an elliptical and gyratory motion the contents of the pan may be kept in agitation allowing heavy materials to find the lower levels, thus making it easy to allow only the lighter portions to be poured portionwise over the edge without any danger of losing heavy material. When a little dexterity has been acquired in doing this, it can be done very rapidly and with great precision. During the last part of this separation it is well to use distilled water.

The final bulk of the solids and water may be reduced to about 100 cc., which are washed into an evaporating dish, allowed to settle thoroughly, the settling taking place quite rapidly. All the supernatent liquid that can be safely poured off with the aid of a glass rod held at the lip of the vessel should be removed, using considerable care.

The residue should now be thoroughly dried and the dried mass carefully powdered. One pole of a powerful magnet, is now provided with a sheath of thin paper, which being thus protected is used to pick up the magnetic particles. On slipping the magnet out of the sheath held over a sheet of glazed paper the attached material, of course, falls off. This procedure should be repeated till examination with a good lens shows nothing but iron and the usually attendant particles of magnetic oxide.

The material may now be weighed on a chemical balance to the nearest

milligram, each milligram representing 0.00004%. It is as well at first to make a trial by adding a known quantity of fine iron filings to a definite quantity of clay and panning it. This will take care of the personal equation, which however will change as skill is acquired, and establish confidence in the result.

By C. C. Treischel:—Mr. Ladoo has provoked a discussion that can not help but benefit both producers and consumers if each will accept their share in the responsibility for the deplorable condition of our feldspar industry for the past few years. The producers' part has been pointed out. The consumers' share is their neglect in providing the producers and themselves with standard tests and specifications covering the different grades of feldspar used in the several branches of the White Wares industry.

The need of such specifications can not be denied. If prepared, they would assist greatly in the reorganization of the producing end of the industry. They would indicate to the producers just what was demanded by the White Wares manufacturers as to quality and uniformity. Standard tests would form a satisfactory law covering controversies over quality, etc. The matter of purchase of feldspar would then be on a sound basis and both buyer and seller would know where they stood.

I suggest that the Committee on Standards prepare suitable physical and chemical tests for feldspar. Further, I suggest that the Research Committee of the White Wares Division prepare purchasing specifications covering the various grades of feldspar used in our industries.

By Charles M. Franzheim:—This is unquestionably one of the best papers I have ever read pertaining to this industry. It is very comprehensive, complete and true to conditions, and I have read it with a great deal of interest and care from a critical standpoint.

How Mr. Ladoo hit the nail so squarely on the head, not being actually in the industry, is a revelation as so very few people in the industry, that is the old people, really get the right angle on the situation and he certainly has done so and is to be commended.

Hardinge mills, to our knowledge, have proven fine where only 100 mesh or less is required, but they have not proven a success, to us at least, where grinding feldspar 130 mesh or finer is required.

Our engineers in Maine, as well as ourselves, have visited all of the high class engineers in the country, sought all kinds of expert engineer's advice for better grinding methods, but so far we have not succeeded in changing our plan, without materially increasing cost. The principal reason for all this is because of the peculiarity of the feldspar rock itself.

However, we wish to congratulate Mr. Ladoo on this feldspar masterpiece. It is the best thing we have read, and hope it will be brought forcefully before the Society.

General Replies

By R. B. Ladoo:—Several discussions of my report on feldspar have indicated that the purpose of the report was not fully understood. When the Bureau of Mines was requested late in 1920, to investigate the feldspar industry the problem presented was: "What are the reasons for the continued shipment of poor and un-uniform grades of feldspar during the past few years and what assurance have the ceramic industries that grades in the future may be improved?" The situation seemed so serious that the Bureau felt that the investigation was justified, realizing, however, that the purpose and results of the work might be misinterpreted by a few people. The purpose of the inquiry, therefore, was to find and list the troubles of the feldspar industry which were directly or indirectly responsible for the shipment of poor feldspar. The point was not to report on all phases of the industry but merely upon the unfavorable aspects. During the course of the investigation much additional material was gathered which will be used in a later report on all phases of the feldspar industry but such additional information was not included in the report under discussion as it was not considered pertinent.

The investigation progressed during the whole of the year 1921. Visits were made to mines and mills and to undeveloped deposits, conferences were held with producers, consumers, consulting engineers and chemists both in this country and in Canada. All collateral information was obtained so as to enable the preparation of an unbiased report representing all phases and interests in the industry. After the report was prepared in a preliminary way copies were submitted to engineers, chemists, ceramists, producers and consumers for criticism, correction and amendment, and the criticisms so received were incorporated in the final report. Therefore, the report as issued represented not the author's hasty judgment but the well-considered opinions and experience of a large number of people representing all phases of the industry.

It was inevitable that the report should be misunderstood by a few people and that they should look upon it as a hasty and unwarranted attack upon the whole feldspar industry in general and upon their own operations in particular. This was anticipated but it was believed unavoidable. The Bureau believed that most producers and consumers would find in the report an impartial and disinterested exposition of the unfavorable conditions as found and that the criticisms would not be accepted where they did not apply. The only alternative to the issuing of the report as it stood

was to write a report which presented the good points and glossed over the weak points. Such a report might have been found more acceptable to a few but it would have been of no value technically and the work would have been wasted.

All of the conditions enumerated in the report were actually found in practice although of course they were not all found in any one plant and some applied to but a few plants.

Some objection has been found to the use of the names of specific machines in the flow sheets presented. It should be understood that the "suggested flow sheet of improved mill" is a composite flow sheet containing methods and machines found by experience to be the most efficient in actual feldspar grinding practice. Thus it is not a theoretical flow sheet but a composite flow sheet of methods and equipment from actual mills. Furthermore, it is not suggested that this flow sheet may be taken as an ideal flow sheet for the grinding of any particular type of feldspar. It is merely offered as a suggestion or as a basis for experiment toward the improvement of present methods. It is fully realized that some of the machines suggested can not be used successfully in the grinding of certain feldspars, but it is true that these machines have been successful in actual use in the actual grinding of other types of feldspars. Furthermore, it should be remembered that improvements in grinding and separating machinery are constantly being made and the fact that a machine was tried out some years ago and found unsuitable is not sufficient proof that the most modern type of this machine would not be successful.

It is true that the unsatisfactory conditions which prevailed in 1919 and 1920 were in part due to labor conditions and to unusually large demand. However, the dissatisfaction with some of the types of feldspar shipped began prior to 1919, and the causes of such unsatisfactory material were accentuated by the unusual conditions. Since the beginning of the industrial depression, late in 1920, feldspar producers have had an opportunity to select their feldspar more carefully, to weed out inefficient labor and to make repairs and improvements in their mills. Thus the feldspar shipped so far during 1922 has been of a better grade and it seems probable that many changes and improvements will continue to be made in the methods of mining and milling.

Engineering and chemical control, to a certain extent, is now being practiced by some of the feldspar producers. This control is more easily effected when the feldspar grinder mills only feldspar from deposits which he owns and operates himself and where such deposits are large and fairly uniform. The greatest difficulties arise when feldspar is purchased in small quantities from a great many different deposits not owned by the feldspar millers and assembled at one mill. At such mills blends must be made and it is very difficult to control the composition of the blend by present methods.

There seems to be some difference of opinion as to the most efficient method of fine grinding. In many of the non-metallic mineral industries, in which fine grinding is necessary, grinding was formerly done in pebble mills of the intermittent type but they have been largely superseded, except for batch grinding, by continuous processes. Thus in the grinding of barite, talc, whiting, etc., very fine grinding is now being done successfully in continuous mills either dry, using an air separator, or wet, using some form of classifier. The specifications for some of these products are very exacting and require material that will pass a 300 mesh screen. Since feldspar need be ground only to pass 140 mesh screen, or at the finest a 200 mesh screen, the possible increase in efficiency by the use of continuous grinding methods should at least not be overlooked.

By R. B. Ladoo (to R. H. Wainford):—It is with some hesitation that I attempt to reply to the discussion by Mr. Wainford for I believe that Mr. Wainford has not fully understood the purpose of the investigation and the meaning of the report. Furthermore some of this discussion is of such a nature as not to need reply. However, I will reply to a few of the technical points made in his discussion.

The nature of the investigation and the type of report desired precluded the possibility of going into details as to possible improvements in methods of mining and milling. The object of the report was to give as concisely as possible the reasons for the production of poor feldspar and a summary of some of the possible remedies. A detailed discussion of all phases of the industry was purposely left to another and more lengthy report which will be issued by the Bureau at some time in the future.

My references to improved methods in other industries were not based upon the iron and steel industries but upon other nonmetallic mineral industries which have passed through the same stage through which the feldspar industry is passing, for instance the cement industry and the lime industry.

The use of flow sheets in describing milling operations is so well established and is so well known that the use in my report seems to require no defense. As for the methods suggested, a careful reading of the report would reveal the fact that the suggested flow sheet was a combination of machines most successfully used in various plants visited. In other words it is a composite flow sheet of the best features of a number of plants. The use of these machines is not advocated for any plants but it was thought that this composite mill might offer suggestions for experimentation in the improvement of present practice.

The points covered in Mr. Wainford's numbered paragraphs one to nine are replied to in part in my general discussion. It is unfortunate that

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Mr. Wainford considered my remarks only in their application to his own operations. It has been repeatedly pointed out that the faults enumerated in my report were but an enumeration of all of the faults found in all of the plants and that they do not all apply to any one plant, but, on the contrary, there are some plants to which but one or two of the faults would be ascribed. However, there is definite and ample proof that all of the faults enumerated may be actually found distributed over the whole industry.

In regard to secrecy of operations it is true that Mr. Wainford extended every courtesy to me while at his plants and I greatly appreciated the coöperation shown. It is also well known, probably to Mr. Wainford as well as other feldspar producers and consumers, that there are companies which are very secretive and which do not allow examinations of their plants and which will divulge no information either to competitors or disinterested parties. Fortunately this applies to but a very few companies.

The feldspar producing capacity of the country was very carefully computed not only from records of actual production but from statements by producers checked by a calculation of actual mill capacities. These estimates do not include flint milling capacity. This estimate clearly showed that there is an excess feldspar milling capacity in the country, a greater excess in fact than some feldspar millers realize or will admit.

By. R. B. Ladoo (reply to Mr. Purdy):—Mr. Purdy's suggested short method of analysis for feldspar can only be applied when the type of feldspar being ground does not change and the only variable constituent is the free silica. It is true that some deposits of feldspar are sufficiently uniform in character so that this method may be applied, but unfortunately there are many deposits which contain extremely variable mixtures of potash and soda feldspars together with free quartz and other deposits which nominally seem to contain only potash feldspar but in which the potash is replaced in variable proportions by soda. Furthermore, most feldspar grinding mills grind material from two or more quarries. Sometimes as many as four or five different feldspars, some of which vary in composition, are mixed and ground together to form a blend. In all of the cases just mentioned a simple silica determination would be of no value, since the ratio of silica to alkali differs in microcline, albite and anorthite.

Unless a feldspar consumer is positive that the feldspar which he is using all comes from one deposit and that the type of feldspar is unusually uniform in this deposit, it would be unsafe and very misleading to depend on a simple silica determination instead of a complete analysis. Since it is not always the practice among feldspar producers to have complete

analyses made of their different feldspars at frequent and regular intervals the potter has no assurance that the type of feldspar which he is using does not change between shipments. If fluctuations in silica content and if the ratio between potash and soda are not seriously objectionable to a potter my objection just stated is of course over-ruled; but one of the greatest objections which I have heard stated by potters to the feldspars which they have received in the past few years has been that it was extremely variable in composition and that this lack of uniformity had occasioned great losses.

The complete analysis of a feldspar is of course a slow and tedious operation but after a thorough study of the subject of analysis and after consultation with ceramists and experienced mineral analysts I have been forced to the conclusion that there are no short cuts which, under ordinary circumstances, can be safely made.

COÖPERATIVE RESEARCH ON SAGGER MIXTURES AND MANUFACTURE[1]

By C. C. Treischel

One of the fundamental reasons for the formation of Industrial Divisions within the American Ceramic Society was the promotion of coöperative research. You have read of the results obtained by the Enamel Division in their investigation of "fishscaling." You have heard of the work which is now being carried on by the Heavy Clay Products Division in their researches on firing problems. The Refractories Division has been engaged in coöperative work for a long time. Other Divisions are falling in line. Is not the time opportune for the groups associated in the White Wares Division to attack some fundamental problems which need to be solved? Does not the spirit of this period, the cry for reducing waste in manufacture, demand some combined effort on our part to strike at the heart of some of the phantoms which have dogged our industry ever since its inception during the middle ages, phantoms which we have all individually attempted to blot out, with at the best, but poor success? I believe that the time and the demand are here and for this reason desire to present for your consideration a research proposition covering one item in our manufacturing expense, an item which in losses is annually costing our industry millions of dollars. This item is "saggers" and our problem is "How can we produce better and longer lived saggers?"

During the past year my work as Secretary of your Division has been chiefly concerned with organization but I have also devoted considerable time considering various problems that have been suggested to me for

[1] White Wares Division, St. Louis Meeting, Feb., 1922.

coöperative research. Among these were raw materials, drying, firing, saggers, glazes, processes, equipment, etc., but the sagger investigation seemed to best suit our demands, *viz.*, a problem of vital interest to *all* of the groups associated in our Division; for only with a vital problem of interest to all the groups could we hope to obtain the coöperation and the financial assistance necessary to carry the researches through to a definite end.

The suggested sagger experiment printed in your programs indicates my personal views of the manner in which a research of this sort should be conducted and some of the points that should be covered. Changes will no doubt be made by those in charge of the work but I believe that these changes will involve additions rather than subtractions.

Table I

Sagger Experiment Suggested by C. C. Treischel for Coöperative Research Problems for the United States Potters' Association

Laboratory

1. Water of plasticity.
2. Drying shrinkage.
3. Firing shrinkage.
4. Compressive strength.
5. Deformation under load.
6. Fusion temperature.
7. Vitrification temperature.
8. Cross breaking strength.
9. Fineness.
10. Experimental mixtures.
11. Effect of rate of drying on strength.

Factory

Methods of Preparation

1. Ground clay *vs.* unground clay.
2. Wet grog *vs.* dry grog.
3. Wet pan *vs.* soak pit.
4. Vertical pug-mill *vs.* horizontal pug-mill.
5. Re-pugging.
6. Ageing of body mixture.
7. Short period tempering *vs.* long period for wet pan.

Method of Forming

1. Power press.
2. Hydraulic press.
3. Hand made.
4. Cast.

Firing

1. Loaded and to temperature of ware.
2. Empty to temperature of ware.
3. Empty to above temperature of ware.

I believe that this investigation can be carried through at an expense of \$50,000. A fairly accurate estimate which I made last summer showed that we have available in this country the equivalent of 3,000 round potter's kilns in which saggers are used. This includes those manufacturers making art pottery as well as those of our own White Wares industry. From data published in our *Journal* and from personal correspondence I estimate that our annual sagger cost is \$20,000,000. If we through coöperative effort could double the life of our saggers, we would save our industry about \$10,000,000 per year. If this saving could be made through an expenditure of \$50,000 would not the expense be justified?

As a method of raising funds necessary to carry on this work, I would suggest an assessment of twenty or thirty dollars per unit kiln for each manufacturer. By unit kiln, I mean a standard size, say $16^1/_2$-foot diameter. If a potter uses 14-foot kilns then use the ratio 14 to $16^1/_2$ in estimating his assessment.

The foregoing, I believe covers the essentials which should be considered.

Discussion

Mr. Sebring:—It seems to me that the experiment should be done by industrial groups. I don't pretend to know the technical end of the business, but I do know something about the cost of saggers in our industry, and it seems to me that our requirements of a sagger would be much different from the requirements of the manufacturers who fire at a higher degree of heat. The highest temperature we reach is about 8 cone. I am wholly in sympathy with the idea of having coöperative research made in order to determine some way of reducing the cost of saggars. The cost at our factory last year was \$3300 per kiln. I make an estimate that the cost on your white ware factories would run about \$2500 per kiln. It seems to me that if the general wares were treated as a group, the electrical porcelain as another group, and so on, you would be able to get some place. I am perfectly willing to pledge now the support of our factories to any amount that is required in order to carry on that work, provided it is carried on by groups. If we try to mix up the experimental work of the electrical porcelain along with the crockery, dish manufacturers, they would not get any place. I would like to go on record as pledging my support, however, to the project as suggested by you with my added suggestion.

Mr. Hunt:—I agree with Mr. Sebring that the requirements for the general wares group are not the same as for the requirements of the porcelain and like industries, but I think the project can be carried out and progress made. I disagree with him in part. I am of the opinion we would get along all right if we started out on the same basis in our experiment with

the others, but the final results should be carried on by the groups. I think the entire thing should be under a central head, but separate work in each industry.

Mr. Treischel:—If this thing were started, I think we would be surprised to find how similar the sagger problems for the various groups in the White Wares Division really are. Considering the basis of our industries as a whole, you will first find, in research, that we will have to deal with fundamentals. It is quite possible that after the fundamentals are established the research will perhaps have to be carried out on a basis of maturing temperature rather than industries. There are a lot of general ware people who are biscuiting as high as the electrical porcelain.

Mr. Sebring:—I do not have the exact figures, but I think there are about 600 kilns in the United States devoted to the making of general ware, and 500 in the making of other ware. All of those 500 fire their biscuit to approximately the same temperature, and it seems to me that if those are treated as one group, you would have something concrete to offer to the members of the United States Potters' Association, and I believe it can be put over. I frankly believe that it would be money well spent if we gave as high as $50 or even $100 a kiln a year for two years, or for as long as it is necessary in order to get somewhere. An assessment of $100 a kiln would mean about a thousand dollars to a factory—approximately $700,000 during a year, yet the cost to each would be very small. That would mean a thousand dollars in order to try and cut down an expenditure of approximately twenty-five to thirty thousand dollars a year—say $100 a kiln as a maximum wouldn't overburden the general ware manufacturers, but in your estimate you say there are 3,000 kilns and cost approximately twenty million dollars a year—that is approximately $6,000 per year per kiln. I am sure that is not the cost of the general ware manufacturers. I do not believe it will run to more than twenty-five hundred to three thousand dollars. But I believe that if you have a definite proposition you would get some place. It is a big problem—it is a problem that we have all tried to solve, even to the extent of using carborundum.

Mr. Sproat:—I think there should be a committee appointed to carry the work on; to investigate the different conditions representing all the White Wares groups.

Mr. Goodwin:—Would not this come under the scope of the work being done by the United Potters' Association Research Committee?

Mr. Treischel:—I do not know. I had hoped to get a chance to go over this matter before this came up. I think the chairman of the different research committees should get together. That is the only way the proposition can be given proper attention and representation. Or the representatives of the groups should get together. The thing that the officers of the Division would like to have is a recommendation,

showing the desirability or undesirability of this coöperative research problem. If you don't want it, we won't go ahead. If you do want it we will try it within another year. If anyone wants to put it in the form of a motion, we can put it in the record as a sort of vote of confidence.

Mr. Sebring:—I will be glad to make that motion. I think it is a move in the right direction. I have given my views, and I should like to make the motion—that it is the sense of this meeting that the manufacturers be solicited.

Mr. Staudt:—I think all the manufacturers are interested in getting closer. I said yesterday during the last twelve years I have been trying to find out how to make saggers and I have not gotten anywhere. Now is the time for us to start something.

Mr. Goodwin:—Would it not be wise to ascertain what is being done in New Jersey?

Mr. Staudt:—We have only done just as much as you have—we have been talking about it—that is as far as we have gotten.

Mr. Sebring:—A Research Committee shall be appointed from this Division. I move then, Mr. Chairman that it be the sense of this meeting that we support a recommendation that there be a coöperative movement between this Division and the various manufacturers who are members of this Association for the purpose of trying to solve the sagger problem. The question as to assessment or financing is a detail that can be handled by whoever handles the proposition.

The Secretary:—You have heard the motion, and it has been seconded.

Mr. Staudt:—I second it once more.

Mr. Treischel:—You have heard the motion all in favor say "Aye." The "Ayes" have it and it is carried.

Discussions since St. Louis Meeting

By Mr. A. V. Bleininger:—I am heartily in favor of a comprehensive study of the subject but I do not think we are ready to proceed at once with actual laboratory and plant studies. In my opinion we should first submit a brief covering our present knowledge of the subject and embodying a critical discussion of previous work. It is not at all unlikely that we already possess important information which will furnish the key to the situation and will greatly reduce the magnitude and expense of the work. It is suggested that either a sub-committee or some individual be delegated to prepare such a report. The outline suggested of work to be done is of too general a nature and we are quite apt to overlook important facts in the mass of testing data accumulated. One of the outstanding needs however is the study of the properties of the commercial sagger clays without reference to specific or special tests. It would be of great service to de-

termine the water content, drying shrinkage, by volume, the burning shrinkage and porosity at different temperatures. This study should not be expensive and would enable us to obtain a clearer idea as to what the sagger clays really are. It is generally realized that such information is not available at the present time. Special studies could then follow this work.

My recommendation therefore is: First, that a survey of the present situation on saggers be made, and, second, that the first laboratory work contemplated be the usual determinations of the properties of sagger clays. It is not unlikely that such work could be done by one of the Federal Bureaus. One of the essential tests I have failed to mention would be the strength of sagger clays admixed with 50 per cent of a standard grog, both in the dry and in the fired state, without reference to the resistance of the materials to load conditions at furnace temperatures.

By Herbert Goodwin:—This subject is one, as we all realize, that calls for study and research which we hope will be taken in hand by the research committee of the organizations interested, yet it would seem to me that a few practical suggestions would be helpful in solving this very vital problem.

Without a doubt, the mixture of sagger clay bodies and the making of a sagger are equally as important as the making of the ware which is to be fired therein, and yet up to this time so little progress has been made in this direction, due in a large measure to the fact that in the building of the potteries, the Sagger Department has been one to receive the least consideration; often cramped in some small quarters so that it could be considered a sagger shop and at other times so imperfectly equipped as to be of no use for the purpose intended. To make a perfect sagger is undoubtedly a problem very difficult to solve, but the first step in this direction after determining the best clays to be used for the purpose would be to weather; secondly, after doing so to wheel them into a drying room where the different clays could be accurately weighed and mixed in their proper proportions with the grog. The latter would have to be determined in a large measure by the use of the different clays. Some clays would permit of some fire clay, others with fine grog, others with the fine grog eliminated, and grog of one eighth mesh. There is only one way to solve this problem and that is by the aid of the Research Committee.

To state at this time the clays which have proven most satisfactory in my experience would be unwise, as it would be better to leave these to the investigations which we hope will be made. As stated by Mr. Hunt saggers which could be used with good results in a semi-porcelain factory would not be so successful in the manufacture of Vitreous China or Tile, as the sagger which is bedded with sand with the ware must have allowances made for the expansion and contraction in cooling which is not necessary with semi-porcelain ware. The study is a very interesting and deep one.

DISCUSSION ON "THE ADAPTABILITY OF THE GAS-FIRED KILN FOR THE BURNING OF CLAY PRODUCTS"[1]

By R. H. Minton:—Mr. Richardson has clearly stated the comparison of the compartment type of kiln as compared with the old periodic type of kiln and the modern railroad tunnel kiln. The strong claim of the promoters of the railroad tunnel type of kiln has been the great saving of fuel as compared with the periodic type of kiln. This saving is accomplished through the ware in the kiln being subjected to direct firing for a short period of time only, due to preheating the ware to a fairly high temperature by the off-going products of combustion, and in addition a considerable amount of heat from the cooling ware is recovered and usefully employed in the burning of the fuel by the preheating of the air for combustion. Exactly the same cycle of operation is employed in the compartment kiln inasmuch as the off-going products of combustion from the chamber fired directly is passing through the chambers ahead, preheating the ware, and the air for the firing of the fuel in the chamber directly fired is preheated by passing through the chambers cooling, thereby cooling the ware and at the same time obtaining the benefit from the highly heated air which shows a corresponding saving in fuel.

The tunnel kiln requires an exact setting of the ware on the trucks to obtain a uniform circulation of heat, but the compartment kiln can be set by any of the known and employed methods in the periodic kiln and still obtain the same remarkable uniformity of temperature throughout the compartment which is of the greatest importance in all cases where a variety of materials are being manufactured. Therefore, the compartment kiln has all the advantages of the tunnel kiln and still allows operation within wide limits. Furthermore, the compartment kiln permits of longer heating and cooling periods which is so essential in the firing of a great variety of ware and will allow of a compact kiln without impairing the firing capacity of the kiln. To obtain similar results with the tunnel type of kiln would require a kiln of enormous length which often does not fit in with the best factory construction. So far as I know, there has never been made any direct comparison of the fuel consumption of the tunnel type of kiln with the compartment chamber kiln. It is doubtful whether the former will show any advantage whatever over the latter in the matter of fuel consumption.

The compartment type of kiln originated in Germany and has been confined almost exclusively to the firing of brick. It has been adapted only to a very limited extent for the firing of other types of ceramic wares. At the former Royal Berlin Works, there is a small compartment kiln of 22 chambers which is used for the firing of hard porcelain. This, of course,

[1] W. R. Richardson, *Jour. Am. Ceram. Soc.*, **5**, 254 (1922).

is a very small kiln as compared with the Hoffman, and similar kilns used for firing brick.

Within the last four or five years, there has been developed in England, a compartment kiln known as the "Shaw Gas Kiln," which has been especially designed and adapted to the firing of the finer grades of ware as well as brick. This is a kiln consisting of 16, or more, chambers, fired with producer gas. At the present time there are two in operation in France and 21 in England, while a number of others are in process of being built. During the past three or four years, the General Ceramics Company has experimented with practically every type of tunnel kiln in the firing of fire clay sanitary ware. None of the trials that were made proved successful, although it can not be said definitely that they might not have been successful under different conditions. However, after investigating every type of kiln, the conclusion was reached that the Shaw kiln was better adapted to this class of ware than any other type so far developed. At the present time two of these kilns are being built in America—one for vitreous sanitary ware and the other for fire clay sanitary ware.

This kiln is now being operated in England for the firing of enameled brick, fire brick, glazed wall tile, architectural terra cotta, vitreous sanitary ware, fire clay sanitary ware, fancy art ware, high-grade pottery, electrical porcelain, general dinner ware and various kinds of bricks, including silica brick. The kiln is being used for the various articles for both the biscuit and glazed firings. In fact, it has been used for practically every type of ware except salt glazed ware.

The operation of this kiln is remarkable for its elasticity, as it may be made to fire quickly or slowly on account of the firing being under absolute control. For this reason it is possible to fire different kinds of ware at different temperatures in the different chambers. On account of the control of the firing, it is possible to regulate the atmosphere of the burning chamber to produce either oxidizing or reducing conditions, as desired. It has been found possible to fire glazed ware without the use of a muffle or sagger on account of the freedom from sulphur, smoke and ash. In firing the kinds of ware which require saggers for placing, it has been found that the life of the sagger is from three to five times as long as in the ordinary kiln.

On account of the ease of operation and the use of a gas producer, the amount of labor in connection with firing this kiln is remarkably low. It has been demonstrated that one man is quite able to handle the firing of the kiln during any shift. The labor of handling the coal and ashes is very remarkably reduced because of the great economy due to perfect fuel combustion. It has been found that the temperature of the burning gases as they pass into the stack are about 100 to 150° centigrade and that all smoke is consumed in the combustion chambers.

The fuel economy in connection with the operation of this kiln seems quite remarkable and in some cases almost beyond belief. In connection with the firing of fire clay sanitary ware, it has been found that the coal consumption amounts to about 15% of what is required for firing of periodical kilns which are believed to be operated quite efficiently. This, of course, is a very remarkable saving. One of the reasons for this is that it is possible in this kiln to fire glazed ware without the use of a muffle, resulting in a very great fuel saving aside from the more complete combustion of gases and the use of the waste heat. This same saving of fuel has been noted in connection with the firing of the various kinds of ware which are being fired in this kiln. For instance, fire brick fired to cone 10 have required a fuel consumption of 400 lbs. per thousand bricks. As the English brick are 3″ thick as against $2^1/_2$″ for the American brick, this consumption would be slightly less in America. For terra cotta ware, the consumption of coal has averaged about 17 tons per 100 tons of ware.

On account of the uniformity of the temperature in each of the chambers and the control of the gases, it is possible to obtain a higher quality of product than is usual with the ordinary kiln. The combustion air passes through six (6) chambers and the heat from the chamber being fired, also passes through six (6) chambers. In a kiln of 16 compartments, this leaves four (4) chambers free for setting and discharging. The actual fire time varies with the class of ware and ranges from 10 hours for table ware glost to 24 hours for heavy fire clay sanitary ware. The firing time governs the number of chambers that may be discharged per week, ranging from 7 to 16 chambers. On account of the preheating of the chambers, the firing and cooling curves are remarkably uniform, resulting in great economy of fuel and remarkable uniformity of quality of the ware throughout the chamber.

As soon as the kilns now being built are completed, an opportunity will be presented for acquiring data on their operation as compared with tunnel kilns and periodic kilns. There is no doubt but what the compartment type of kiln will receive more attention in the future in connection with the firing of all types of ceramic wares.

DISCUSSION ON "LAMINATIONS, DISCUSSION OF CAUSE AND CURE"[1]

By R. B. Keplinger:—Mr. Brand's nomenclature and definitions applying to the two forms of lamination seem to meet all requirements. The local terminology for these two types is "differential" and "auger" lamination, for which latter the term "interfacial" is probably more inclusive and broader in description.

It is believed, with Mr. Lovejoy, that distortion of the clay blank in the

[1] *Jour. Am. Ceram. Soc.*, **5**, 355 (1922).

mould box under pressure of the repress plunger simply serves to intensify the separation of the clay along the planes of the laminae already included in the blank—if even this is the case, which our experience has gone far to disprove. In paving brick manufacture it is mainly desired to remedy the extreme type of differential lamination, which is generally more marked at the ends of the block than on the top and bottom surfaces, as of course the ends are already the weakest portion structurally of the block unit. The familiar herring-bone evidence of interfacial lamination, when present in marked degree, is usually so far in the interior of the block that the grind of traffic or the abrasion of the rattler will not discover a structural weakness. Fairly consistent evidence can be cited that repressing actually tends to "heal" or reunite the laminated surfaces at the ends of the block and while holding no brief for the repressing process we have less difficulties securing sound ends manufacturing repressed block, than straight wire-cut or bulged end block. This of course applies only to this material, a fairly gritty shale. Furthermore, in burning, the ends of the block exposed to the impinging action of the flame, creating differential shrinkage strains, will show intensified lamination when compared with thoroughly vitrified ware from the lower middle courses. These latter are subjected to the very considerable weight of the upper courses, which tends again to heal these lamination planes when heated to incipient viscosity in the course of the burning.

I do not quite agree with all Mr. Brand says about die lamination and the action of the clay in the nozzle and die of the machine. Mr. Claude Fuller's experiments at Buffalo, Kansas, using a well known standard make of paving brick machine, first convinced me of the soundness of the "interlocking cone" theory of clay bar structure. He demonstrated this, quite ingeniously, by painting a cross section of the clay at the throat of the machine and then replacing extension and die; he ran the bar out, dried it and carefully dissected it to uncover the painted surfaces. This of course would not demonstrate the action of the auger upon the clay except subsequent to the clay passing the point of the auger. It was found necessary, at Buffalo, to reduce the taper of the nozzle and slightly extend its length, thus reducing the friction and resistance to the passage of the clay, producing a shorter "cone" length and lessening the differential flow. We have demonstrated this, at least to our partial satisfaction, after experimenting with various combinations of nozzles, extensions, dies and augers. When one considers the fact that on a great many paving brick plants the passage for the clay is reduced from a fifteen-inch auger diameter to the rear opening of the die whose finished size is approximately 4 inches by 9 inches, in a lineal measurement of but a few inches, it is almost impossible not to conceive of the tremendous differential stresses involved.

In endeavoring to remedy this differential flow the experimenter is lim-

ited by the design of the standard type of machine. To approximate a straighter nozzle one must reduce the diameter of the tapered nozzle at the larger end. This reduces the wing surface with respect to the size of the hub, so we must have smaller hubs, hence smaller shafts. If we can go this far we find we have a greatly reduced capacity. This can be remedied by speeding up the R.P.M. or by increasing the pitch of the augers and propeller whether of single or double wing type. At this point it will probably be profitable to scrap the machine and re-design one to suit the requirements.

At the present time I have before me a blue print showing the nozzle lengths, and reduction in diameter of these nozzles from rear to discharge end, of twenty-two standard brick machines with which paving brick can be made. These nozzle lengths vary from one foot to twenty-eight inches, and the reduction in diameter shown by these nozzles runs from three inches to thirteen inches. Yet all of these machines are supposed to be capable of turning out A–1 paving block from shales having similar properties and qualities.

Whether, by returning the clay to the machine often enough, differential lamination will disappear, appears rather doubtful and extremely difficult of proof. Mr. Brand's assumption that by increasing the lines of cleavage until it is impossible to further subdivide the clay layers, he will secure a clay which for all intents and purposes, will be non-laminated and with a lower plasticity, might hold if the cleavage planes and layers of clay ran in the same direction and were superimposed with each journey through the machine. Otherwise it would seem to be necessary to run it through an infinite number of times. My experience has been that when our material has been run through more than two or three times it is unfit for the manufacture of paving brick. I agree that increasing the distance between the die and the auger will help to eliminate auger or interfacial lamination in gritty clays; but have also found that it increases the differential flow. This is more clearly emphasized by the large increase of power consumption when this dimension is appreciably lengthened. It would be perfectly possible, theoretically, to arrive at a certain distance of the die from the auger, at which distance it would be impossible to apply sufficient power to the machine to operate it, without wrecking it.

Mr. Brand's theory of occluded air must certainly be received with respect. It furnishes a reasonably satisfactory answer for many obscure results, such as the "bulge" or swelling of the column at the die. As to whether the blisters that form on the surface of the column of clay are due to the expansion of occluded air or to other internal strains or stresses within the bar, causing a surface lamination which, released from confinement of the die, or due to incipient surface drying, cracks or bursts open, I can hazard no conclusion.

mould box under pressure of the repress plunger simply serves to intensify the separation of the clay along the planes of the laminae already included in the blank—if even this is the case, which our experience has gone far to disprove. In paving brick manufacture it is mainly desired to remedy the extreme type of differential lamination, which is generally more marked at the ends of the block than on the top and bottom surfaces, as of course the ends are already the weakest portion structurally of the block unit. The familiar herring-bone evidence of interfacial lamination, when present in marked degree, is usually so far in the interior of the block that the grind of traffic or the abrasion of the rattler will not discover a structural weakness. Fairly consistent evidence can be cited that repressing actually tends to "heal" or reunite the laminated surfaces at the ends of the block and while holding no brief for the repressing process we have less difficulties securing sound ends manufacturing repressed block, than straight wire-cut or bulged end block. This of course applies only to this material, a fairly gritty shale. Furthermore, in burning, the ends of the block exposed to the impinging action of the flame, creating differential shrinkage strains, will show intensified lamination when compared with thoroughly vitrified ware from the lower middle courses. These latter are subjected to the very considerable weight of the upper courses, which tends again to heal these lamination planes when heated to incipient viscosity in the course of the burning.

I do not quite agree with all Mr. Brand says about die lamination and the action of the clay in the nozzle and die of the machine. Mr. Claude Fuller's experiments at Buffalo, Kansas, using a well known standard make of paving brick machine, first convinced me of the soundness of the "interlocking cone" theory of clay bar structure. He demonstrated this, quite ingeniously, by painting a cross section of the clay at the throat of the machine and then replacing extension and die; he ran the bar out, dried it and carefully dissected it to uncover the painted surfaces. This of course would not demonstrate the action of the auger upon the clay except subsequent to the clay passing the point of the auger. It was found necessary, at Buffalo, to reduce the taper of the nozzle and slightly extend its length, thus reducing the friction and resistance to the passage of the clay, producing a shorter "cone" length and lessening the differential flow. We have demonstrated this, at least to our partial satisfaction, after experimenting with various combinations of nozzles, extensions, dies and augers. When one considers the fact that on a great many paving brick plants the passage for the clay is reduced from a fifteen-inch auger diameter to the rear opening of the die whose finished size is approximately 4 inches by 9 inches, in a lineal measurement of but a few inches, it is almost impossible not to conceive of the tremendous differential stresses involved.

In endeavoring to remedy this differential flow the experimenter is lim-

ited by the design of the standard type of machine. To approximate a straighter nozzle one must reduce the diameter of the tapered nozzle at the larger end. This reduces the wing surface with respect to the size of the hub, so we must have smaller hubs, hence smaller shafts. If we can go this far we find we have a greatly reduced capacity. This can be remedied by speeding up the R.P.M. or by increasing the pitch of the augers and propeller whether of single or double wing type. At this point it will probably be profitable to scrap the machine and re-design one to suit the requirements.

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DISCUSSION "NOTES ON DIAGNOSING CAUSES OF CORDS IN GLASS"[1]

By F. Gelstharp:—Any devised method of diagnosing defects in glass which goes beyond the possibilities of chemical analysis is deserving of much credit even if it gives nothing more than a suggestion as to the cause. Mr. Twyman by means of optical methods enables the chemist to obtain certain properties of the particular defect known as cords, which may in some cases lead the way to their elimination.

Cords have always been considered as a glass varying more or less in composition from that of the general mass. And my experience has been that a chemical analysis of the cord and surrounding glass compared with that of the glass free from cord will show an excessive amount of alumina and silica sometimes associated with an excessive amount of lime, but in the latter case it has often been traced directly to localized impurities in the limestone, whereas, where the lime content corresponded with the alkali, the presence of cords has been due to solution of clay, no doubt originating from the furnace or tank walls, entering the glass as a drop from overhanging clay work. Often such drop formed cords are colored more or less by impurities in the clay. I have generally been able to diagnose the cause of cords by making painstaking chemical analysis, and I personally welcome the rapid optical methods described by Mr. Twyman as they provide further data which would help one to draw the right conclusions, in many cases making it unnecessary to obtain a chemical analysis. And where the cord was very slight (in which case a chemical analysis would be unsatisfactory). The optical method would at least give some clue.

DISCUSSION ON "MICROSCOPIC STUDY OF GROUND COAT AND COVER COAT ENAMEL REACTIONS"[1]

By B. T. Sweely:—Mr. Geisinger has opened a new field to investigation in the enamel industry. I think the author is to be congratulated on his very careful work and on the very able preparation and presentation of the data contained in this paper.

Unfortunately, Mr. Geisinger's results and conclusions are not applicable to the sheet steel enamel industry, directly. His work has been confined entirely to the fishscaling and shivering of finish enamels as we know them, and not to ground coats and grey ware or one coat enamels.

Light steel, such as is used for cooking ware, etc., usually will not fishscale badly, after the second coat of enamel is applied, probably because sufficient strength is secured in the two coats to resist the stress set up by

[1] F. Twyman, *Jour. Am. Ceram. Soc.*, **5**, 289 (1922).
[2] E. E. Geisinger, *Jour. Am. Ceram. Soc.*, **5**, 322 (1922).

the contracting steel. Further, most of such ware, being enameled on both sides, is further protected against failure in the characteristic fishscale form, by the fact that after the second coat of enamel is applied, there are in reality four coats of enamel to resist the stress set up by the greater contraction of steel over enamel, and consequently failure or fishscale seldom occurs on such ware in the second coat.

In enameling heavy plate, however, such as was used by Mr. Geisinger in his work, it would seem quite probable that fishscale would occur after the second coat was applied, as a very heavy steel is used and the enamel applied to one side only, the finished piece having far from sufficient enamel to counteract the stress set up by the contracting steel.

From the above, therefore, it would seem that Mr. Geisinger is dealing with and speaking of an entirely different set of conditions than those that were under investigation in the work of Danielson and Souder. The latter writers were working with thin sheet, from 22 gauge to 28 gauge steel, enameled on both sides, with but one coat of enamel, and the fishscale encountered in their work occurred in this one or first coat of enamel and not in a subsequent cover coat, and it is with this type of failure of ground coats or grey coats that the enameler usually has to contend, and not of the finish enamels. It would be interesting to know whether Mr. Geisinger has ever experienced fishscale to any great degree in his ground coats, and if so, whether the same conditions obtain in regard to the enamels resistance to fishscale as was observed in his work on cover enamels.

It has been the writer's observation, that bubble formation in ground coat enamels is very prevalent, in fact under even a low power glass, most ground coats reveal a very large number of minute bubbles, and it might well be that this bubble structure, or the lack of it, plays an important part in the fishscaling of first coat and grey ware enamels under varying conditions.

Aside from its effect on the fishscaling of finish enamels as Mr. Geisinger has so nicely shown in this paper, it has occurred to me that this bubble structure in finish enamels might play an important rôle in the resistance of kitchen ware, to thermal shock and impact. I should be very much interested in hearing from the author of this paper, whether he has ever investigated the possible relation of this structure of finish enamels to the above mentioned physical properties of enameled steel ware.

DISCUSSION ON "PAINTING IN UNDERGLAZE COLORS ON THE BISCUIT"[1]

By Paul E. Cox:—1. In Mr. Rhead's paragraphs dealing with mediums, under the heading "Painting Mediums," sub-head "Water" he

[1] F. H. Rhead, *Jour. Am. Ceram. Soc.*, **5**, 376 (1922).

notes the trouble with dusting, or rubbing of the color. It has come to my attention that one well-known studio pottery overcame this trouble very satisfactorily, in fact with entire success, by quickly dipping the painted piece into clear water just before dipping in the glaze. This set the color so that it did not wash off in the glaze, though likely enough a little was lost in the water dipping, and a trouble with "crawling" of the glaze was stopped, this "crawling" being due to the dust of the color in the thicker deposits of color. It may be noted that a little gum tragacanth had been used in the under glaze color as originally applied.

2. Under the heading "Use of Underglaze White" mention might be made of the use of a dark clay made white on the surface only by the use of a suitable engobe. Such a surface is good for underglaze painting on the unburned piece or on the biscuit, as is desired. It ought to be possible likewise to borrow from the Collected Writings of Dr. Seger, and to make use of a white ground in the form of a tin enamel, carrying the underglaze colors, the colors being covered in turn by either a clear glaze or a translucent glaze, as desired. Seger spoke of two clear glazes being so used.

3. Under the heading "Preparation of Surface for Painting" the plan followed at Newcomb Pottery for the preparation of a surface might be followed in addition to those plans enumerated. The leather hard piece is carefully sponged so that the texture lines take the direction desired by the artist, doing away with a difficulty where thin washes are used that manifests itself in streaky looking work. It is probable that experiment would reveal a number of ways of securing textures that would yield special results and secure desirable effects where light washes are used. The air brush is of course a method, where even grounds are wanted.

4. In Table I, the use of zinc oxide in both the French green and the olive green strikes one familiar with the usual effect of zinc on greens obtained from copper and chromic oxide as a thing to be studied. In ceramics no one can say a thing is impossible but this is unusual.

5. In Table III zinc oxide again appears but in relatively small amounts. The suggestion might be made that the borates offset the effects of zinc oxide in the several cases. Mr. Rhead does not indicate what the fritt proportions are in his glazes, and it will be noted that these glazes are English in origin. This is not to say that they are not good glazes on that account, but a paper of this sort appeals to the amateur as well as the professional potter, and it might be well in another paper to point out how these glazes might be made up from American materials only. It is to be supposed that the borax is in such small amounts that it functions as a soluble salt, but the ground glass is not stated as to composition. Since no bodies are named on which to make use of these glazes it might be worth while to specify all raw materials, about which there might be doubt.

6. In the use of Liquid Underglaze Colors is it possible to make use of

organic dyes as a help in application of the colors? Newcomb Pottery, acting under a suggestion from the writer, makes use of carbonate of copper as an underglaze green, and as this is a precipitated material this has proven a very satisfactory underglaze color. Doubtless other precipitated mineral salts would prove equally satisfactory.

7. For the amateur a description of the process of ground laying used in the white ware industry would be of interest, reference being made to that process where cotton pads are used for the application of dusty color to an adhesive coated surface.

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A Monthly Publication Devoted to Proceedings of the Society, Discussions of Plant Problems, Discussions of Technical and Scientific Questions and Promotion of Coöperative Research

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Vol. 1 August, 1922 No. 4

EDITORIALS

CONVENTIONS

The American Ceramic Society is planning for three conventions to be held in the immediate future: (1) Summer Excursion Meeting the week of August 13; (2) Ceramic Day at National Exposition of Chemical Industries the week of September 11, and (3) the Annual Meeting, in this instance the twenty-fifth anniversary, the week of February 12, 1923. Do these "get togethers" pay dividends commensurate with the invested time and money of those who attend?

Many hundred conventions are held each year. All sorts of mercantile, manufacturing, agricultural, professional, educational, scientific, political, social and fraternal groups meet at least once a year and some of them more often. Committees of all sorts hold frequent meetings, the members often traveling long distances at large expenditures of time and money. Are the benefits derived from attendance at conventions and committee meetings commensurate with the costs to the individuals and to the concerns which these individuals represent?

Rather than evaluating these benefits it is sufficient for the purpose at hand to consider only the circumstantial evidence to prove that attendance at conventions must repay more than the monetary equivalent of time and money expended, or the attendance at conventions would not be constantly increasing, and there would not be such a remarkable in-

crease in the number of conventions each succeeding year. Convention bureaus, reporting agencies and convention journals find an increased demand for the peculiar service which each renders. Conventions have been recognized as business, political, educational and social necessities. An increasing investment in conventions by the leaders in every walk of life bespeaks the solid values enjoyed by those who attend.

Summer Excursion.—The Summer Excursion Meeting of this Society which is routed from Rochester, N. Y., to Montreal, Buckingham, Ottawa, Verona, Kingston, Toronto and Hamilton will have a peculiar value for those who attend in (1) broadened and intensified acquaintance with fellow ceramists; (2) mutual exchange of experience and information on manufacturing problems; (3) increased knowledge through inspection of manufacturing plants and feldspar quarries; (4) cultural advantages of travel to cities of individual and universal interest; (5) cultural benefits of acquaintance with persons who have accomplished important work; and (6) an invigorating outing on lake and river, through some of nature's most beautiful and most thrilling scenes, and to places that range from the most sophisticated cities to the backwoods camp. Such a wide variety of benefits is seldom obtainable from conventions as is offered by this Summer Excursion Meeting.

Chemical Exposition.—The convention in New York City in connection with the National Exposition of Chemical Industries is well established as an occasion of profit to those who attend. It is sufficient in this writing to say that our program committee under the leadership of Mr. R. D. Landrum and the secretaries of the several Industrial Divisions of the Society is planning a day of interest and value. The Exposition is a broad educational institution well worth the time and expense of a thorough study by ceramists.

As for our **Silver Jubilee Convention** next February in Pittsburgh, it will be the biggest meeting in the interest of coöperative Ceramic Research yet held. The Divisions and Committees are making plans for a potent occasion for advancing the ceramic arts and sciences. The Charter members are planning to renew the spirit of a quarter century past which prompted them in the face of industrial opposition to begin this mutual exchange of knowledge and coöperation in investigation of unsolved problems. The younger members are planning to show the results of present day broad-minded and hearty participation in coöperative research.

Ceramic workers can ill afford to neglect the advantages offered by these well planned conventions. It is expected that a goodly number will attend each of the three meetings now scheduled.

SERVICE AND COST

A Chat with The Secretary

Increased Service at Less Cost.—The recent numbers of the Journal have been remarkable in several respects. The increase in number of original papers and discussions, and of abstracts of the world's literature is self-evident to the casual observer but few we find who have observed the greater length and width of the printed column on each page, by means of which the amount of reading matter per page is increased more than 26 per cent. If the printed matter in the April number had been in this wider and longer column it would have needed only 66 rather than 88 pages.

Savings Are Re-invested in More Service Rendered.—We wish to stress the point that this 26 per cent greater capacity column gives a net saving per material printed, which saving is re-invested in more printing. It is this sort of economy in the interest of the subscribers that the Committee on Publications is studying so as to give even greater returns for membership subscriptions.

Scientific management and cost systems have been worked out for printers with resultant fixed scale of charges which makes the working tools of the Society cost much more now than they did before the war. This in turn calls for closer managing on the part of the executives of the Society, and, even with close managing, expenses cannot be met without the assistance of the members.

Expenses Have Increased but Membership Dues Have Been Kept Low.—The officers of the Society are constantly striving to give more and more service without increasing the annual subscription, but even with the most thrifty shopping for the working tools, the officers are at all times confronted with the fact that there are only seven hundred and fifty cents in each personal subscription. This Society is unique because the low personal membership dues have been maintained in spite of the increased cost of everything.

Journal Published at a Loss.—In the year 1921 the Journal, though small, was published at a loss of over $5,000. The exact figures are given in the Year Book. This year the executives of the Society courageously trusted to the coöperation of every member and to the farsightedness of corporations, in their decision to issue an even larger and more costly Journal, on the grounds that such was absolutely necessary if the Society was to assume its just obligations in these days of more earnest seeking for technical and scientific information. They assumed that persons interested in ceramics and in their own welfare would secure additional subscribers to the support of the greater service thus rendered. These expectations have been realized to some extent and it

is confidently expected that the full quota of required new members will be secured just as soon as the members realize the larger advantage that accrues to each individual and to each corporation from a more virile and productive organization.

Importance of Greater Membership Support.—Self-evident should be the greater things which could be accomplished when the membership is brought to the full strength required for this Society to meet its obligations in the more aggressive coöperative research program on which the ceramic industrial groups are now engaged. The Trade Associations, the Trade Journals, the Federal Bureaus, the Universities and the manufacturing concerns need this central organization devoted solely to technical and scientific research. They are coöperating agencies each engaged on its special problems but each dependent upon the American Ceramic Society, as upon each other, to have sufficient strength and be sufficiently productive to work into a unit structure the results obtained by them and by individuals so that each may have the benefit of information obtained by the others on the many things that are of common concern.

The executives will continue to plan ways and means of obtaining the most for those who join in support of this Society, but the most urgent thing right now is the presentation to many others that it is not only their duty but their opportunity to share in the support of this work.

If you are of the belief that your membership support is a good investment for you, why not increase the value of your membership by inviting others to share in the returns. This is the only way you can receive greater service at the same cost.

EDWIN WARD TILLOTSON, JR.

Edwin Ward Tillotson, Jr., a recognized authority on the chemistry and technology of glass, and Assistant Director of the Mellon Institute of Industrial Research of the University of Pittsburgh, was born at Farmington, Conn., on February 28, 1884. He received his professional chemical education at Yale University and was graduated in 1906 with the degree of B.A.; in 1909 he received the degree of Ph.D.

Following the completion of his graduate work at Yale, Dr. Tillotson joined the Department of Industrial Research of the University of Kansas, where he remained for four years as an Industrial Fellow. In 1913, he came to the Mellon Institute of Industrial Research as Assistant Director. The scientific investigations carried out by Dr. Tillotson at the University of Kansas related to a study of the relation between the optical properties of glass and its chemical composition. The scientifically important results

of this research were published in a series of six papers in *The Journal of Industrial and Engineering Chemistry* (1911–12). His recent publications include:

Etch figures, *J. Ind. Eng. Chem.*, **9**, 937 (1917).

Molecular Compounds, *J. Amer. Ceram. Soc.*, **1**, 76 (1918).

The New Factory of the Monongah Glass Co., *J. Amer. Ceram. Soc.*, **4**, 3–24 (1921).

Putting the Glass Industry on a Scientific Basis, *Chem. & Met. Eng.*, **23**, 461 (1920).

Waste in the Glass Industry, *Chem. & Met. Eng.*, **25**, 437 (1921).

The Manufacture of Constructional Glass in the United States, *J. Soc. Chem. Ind.*, **40**, 155 (1921).

Dr. E. W. Tillotson, Vice-President American Ceramic Society, Asst. Director, Mellon Institute of Industrial Research, Pittsburgh, Pa.

Dr. Tillotson is now in supervisory charge of all the Mellon Institute investigations in the field of ceramics, in addition to other research work of the Institute.

Dr. Tillotson is an active member of the American Chemical Society and of the American Ceramic Society. He is a past chairman (1920) of the Pittsburgh Section of the American Chemical Society and at present is a member of the Council of the Society.

In the affairs of the American Ceramic Society he has held the following appointments:

Committee on Publications, 1919–.

Secretary of the Glass Division, 1919–1922.

Vice-President, 1922.

Amer. Ceram. Soc. representative on A.S.T.M. Committee D-10, 1922.

ACTION OF REFRACTORIES UNDER LOAD CONDITIONS AT HIGH TEMPERATURES

The "load test" is now used in all countries and is considered one of the most important in the testing of refractories. Very few there are who know when and by whom it was devised and first used, hence this note of acknowledgment.

The action of refractories under load conditions at high temperatures was first studied by Lemon Parker and reported by him in a paper before this Society in 1905. This test was developed and refined by Professor A. V. Bleininger in subsequent years but the credit for the basic conception

belongs to Mr. Parker. We are pleased that we can make this acknowledgment of credit as belonging to one of our fellow members while he is yet active in the affairs of the Society.

Mr. Parker has been engaged in the manufacture of fire-clay refractories since 1886, serving in various capacities in the Parker-Russell Mining and Manufacturing Company. He was made President and General Manager in 1915.

It was in 1902 that this company was forced to use a high alumina clay in substitution for the silicious clays which they had been using in bench tiles. The situation demanded the adoption of tests that would involve the critical service factors, and which could be quickly executed with reliable results. This caused Mr. Parker to invent the load test.

SURVEY OF SIMPLIFICATION NEEDS TO BE CONDUCTED BY AMERICAN ENGINEERING STANDARDS COMMITTEE

At the request of Secretary Herbert Hoover, of the Department of Commerce, the American Engineering Standards Committee will undertake at once a canvass to determine what simplification in manufactured products is most needed and most desirable. This canvass will be conducted through the engineering and technical bodies having representatives on the Committee or coöperating in its work. The survey of simplification or standardization needs and possibilities will extend into almost every industry in America.

This assignment to the American Engineering Standards Committee is one of Secretary Hoover's steps to retrieve for American Industry a few of the many billions of dollars wasted annually, as revealed in the report on waste in industry which was made not long ago by a committee also appointed by Mr. Hoover while he was chairman of the Federated American Engineering Societies. The latter committee found that waste in industry was due largely to an overmultiplicity in number of products as well as to inefficiency in process.

Of equal significance is the fact that Mr. Hoover's request that the American Engineering Standards Committee conduct this survey and the acceptance of the assignment by the Committee indicate a coördination of the work in the simplification of manufactured products, sponsored by Secretary Hoover, and the work of the American Engineering Standards Committee in the unification of standards on a national basis.

What should be the relationship between the simplification work of the Department of Commerce and the standardization work of the American Engineering Standards Committee has been the subject of considerable discussion. It is clear now that there will be no duplication or overlapping. There seems to be general recognition of the fact that simplification of

product and improvement of process are to a large degree only other words for standardization: that they are standardization put to work. The joint movement for standardization and simplification may, therefore, be said to have begun its work in its own household by standardizing, simplifying, and unifying its own machinery and processes.

The Executive Committee of the A.E.S.C. has, by resolution, pledged the coöperation of the Committee to the Department of Commerce. Representatives of the Committee recently held a conference on the subject with Mr. Hoover at Washington. Subsequently an arrangement was made for permanent exchange of representatives between the two organizations so that there may be the closest possible coöperation between the Commerce Department's Division of Simplified Practice and the American Engineering Standards Committee.

THE EVOLUTION AND DEVELOPMENT OF GLASS HOUSE EQUIPMENT

By J. S. Herzog

ABSTRACT

This paper is an account of the evolution of machinery used in glass-making in which the modern methods are contrasted with the old. *Gas producers, gas burners* and *oil burners* are discussed. In burning gas a greater efficiency obtains when the air entirely surrounds the gas stream as it enters the fire box. In burning oil the high pressure costs more for installation but is more efficient. The tendency is towards automatic machinery for all glass-making operations. Many machines are well nigh perfect but improvements are being made constantly. Mention is made of the need of a better alloy for metal molds. In the glass industry labor represents on the average 40 per cent of the cost of the product. In this respect the glass industry ranks thirteenth.

While glass-making is one of the oldest of the manufacturing industries, it is also one of the newest from a basis of the development of manufacturing processes. Authorities differ as to the origin of glass, but it is very probable that the Egyptians were the first manufacturers in a commercial way. They made glass by a primitive process between 1600 and 1500 B. C.

Geographically and chronologically in the line of development we might list glass manufacture thus: Egypt, Rome, Venice, Germany, Bohemia, France, England, and the United States.

While the ancients produced a great variety of glasses, some of which we have not been able to duplicate, the greatest development in the handling and forming from a purely commercial view-point has been during our time. Due credit must be given them for the processes used as many of our most modern methods are but improved application of those processes.

Pressing glass by means of metal forms was known to the Egyptians; glass replicas of their coins of the time of Thebes have been found. The exact origin of the blowpipe as used in glass manufacture is unknown. It is sufficient to say that it was first used by the Egyptians the second or third century B. C. The application of these two very old processes form the basic foundation of our present day equipment in the shaping or manufacture of glass articles.

Up to the latter part of the last century these processes and their application were but slightly developed. The medal for progress made in the evolution of glass factory equipment for both hemispheres during the past fifty years, belongs without a question of doubt to this wonderful country of ours. The use of gas for fuel has been the greatest factor in this development.

This paper proposes to cover in general, and in many instances in a detailed way, equipment adapted for the glass factory, for fuel, raw material, melting, shaping, tempering and finishing—that is, grinding, polishing and decorating.

In the old days, when wood was the principle fuel used, glass factories were built in or near forests. The locations of our present factories were primarily determined by the fuel supply. After wood, coal, natural gas—and with the exhaustion of natural gas, coal again—have been the dominant factors in the location of glass factories.

With the depletion of natural gas, gas producers and the use of fuel oil have made it possible for glass plants to continue in their original locations. Gas producer plants are of two principle types, raw and washed gas; the latter is the more complete, although the former is the more common type used for glass-making. There are many types of raw gas producers on the market, essentially similar in their general design, differing principally in the degree that they are automatic.

The success of any installation, as to obtaining results at the point of combustion, depends largely upon the arrangement and operation of the tunnels, pipes, dampers and valves. Beginning with a steel or brick tank fired by wheelbarrow and stirred or stoked with a long iron rod, we find today producer plants alone costing many times the former price of a complete glass plant.

Coal arrives at the plant in hopper bottom cars, dumped into surface receiving hoppers, from there conveyed by bucket or belt to the crusher and by the same means to storage tanks over the producers. From these tanks the producers are charged by gravity automatically through the receiving head of the producer. Some part of the producer rotates around a vertical axis. This causes the necessary operation for the stoking or raking and cleaning of the fire. The ashes are automatically cleaned away from the lower part of the producer and conveyed to the dump or storage. The entire process requires one man who manipulates the levers and pushes the buttons.

Several types of raw gas burners have been developed. These burners provide for the mixing of air with the gas as it enters the fire box. Volume air is blown either through or around the gas discharge. The more efficient seem to be so constructed that the air entirely surrounds the gas as it enters the fire box. These types differ only in the places where the air and gas enter the burner and the method of controlling their flow.

Crude oil for glass manufacture is comparatively a new fuel. At present there are two distinct methods used in the industry. Crude oil must be gasified or atomized for successful combustion. The two methods apply to the atomizing process. The common method and the one having the lesser cost of installation consists in atomizing the oil by compressed air at the burner. The oil burned by this method is conveyed by gravity or low pressure pumps to the burner. Fuel oil that reaches the burner under an extremely high pressure is the other method. The pressure back of the oil at the burner atomizes it. The high pressure method

has a higher installation cost, but so far has proven more efficient and economical.

In both methods, whether the oil is stored under or above ground, due care must be exercised in the installation of the system, particularly in the colder districts, and provision must be made for the warming of the oil by the use of steam pipes, both in the storage tanks and the conveying lines. Heat increases the fluidity of the oil and facilitates its handling.

There are a great number of burners on the market, most of them for the more common method of atomizing by compressed air applied at the burner. They differ in their construction only in the method of receiving and distributing the oil and compressed air, and their manner of control. All burners for this method should be provided with facilities for cleaning.

The old glass manufacturer had but one fuel problem—to get his wood cut and hauled to his plant. It is not an infrequent sight in the depleted natural gas districts, to see glass factories equipped with three burners on the tanks and lehrs, for raw gas, natural gas and fuel oil. Two conditions govern as to which is in use, supply and cost.

The handling of raw material has developed with the other departments of glass manufacture, while the wheelbarrow and the hand-shovel are the only raw material handling equipment available in many glass factories, the larger and more modern are supplied with automatic equipment. As raw material for many factories is received in box cars, the power shovel is used to unload cars into hoppers from which it is conveyed to the storage tanks by belt or bucket conveyors. These tanks are circular in cross section, with capacities for from three weeks to ninety days normal consumption. There is a tank for each kind of raw material, and sub-divided tanks for materials whose consumption is not so great. These tanks are made of steel and cement. The poured cement tanks seem to be more satisfactory owing to their lower cost of upkeep. Passages are provided under these tanks either for batch mixer car or belt conveyor. The modern factory where economy and quality are desired, should have its cullet crusher, batch mixer and separator.

Quoting from an authority on glass manufacture, "All materials should be reduced to a pulverized condition. There should be a thorough admixture of the batch. By reducing all particles to their finest possible condition, while in a raw state, a closer mechanical association is affected and they expose more surface to all reducing influences, effecting an earlier fusion of particles and a closer combination of results. A thorough admixture of materials is necessary so that *in* the chemical association each particle of sand may find its corresponding portion of alkali, oxide, etc."

Installations of equipment for handling raw material vary as to kind of product, arrangement of plant and money available. In designing an ideal installation, let us assume our product is high grade milk bottles in

large quantities, and we are melting our glass in continuous tanks. We have an inbound siding for our raw material. With the given normal production of our glass melting tanks we erect the necessary number of storage tanks of concrete, with conical tops and flat bottoms; and coat the inside of our tanks with a moisture preventative; the size and number of these tanks to hold raw material for thirty days normal production. We will use the portable type of upright conveyor with power car unloader. The tanks will have two or more properly gated openings in the bottom. There should be a tank for cullet with the crusher mounted under the opening. They should be supported high enough to permit the free passage of combination batch car, scales and mixer, and operated either by electricity or gasoline. The thoroughly mixed batch is dumped into a floor hopper and from there conveyed over separator and thence to storage tanks over dog houses. These tanks are to hold twenty-four hours requirements and are discharged by gravity. Where pot furnaces are used, the foregoing installation could be modified by the use of hand-drawn or power-driven steel batch carts.

The modern furnaces and tanks used for melting glass, besides varying in size, differ in the application of the regenerative and recuperative principles. These processes are of sufficient importance to entitle them to a discussion beyond the scope of this paper.

Tank melting is rapidly crowding out pot melting for commercial products. Except for optical purposes, as beautiful crystal glass is made in tanks as was ever made in pots. Tanks are now in use with dividing partitions and two colors are made in the same tank.

In the operation of the regenerative type, there has recently been put on the market a combined gas and air valve that reverses automatically. It is operated by thermostatic control from the checker work.

Shaping and forming of glass articles was accomplished in a very crude way in the early years of the last century. The blower's pipe and the pontil were the principle tools used. These were supplemented by small tools made of wood and metal and later with molds made from apple or maple chunks.

Up to 1899 glass was taken from pots or tanks by blower's pipes, pontils or ladles. Since then many methods have been developed and patented. The success of the suction process was possibly the incentive that brought out the others. There are five important essentials for the success of any automatic gathering or feeding device.

1. The amount of glass supplied must be adjustable within a reasonable range.

2. The gather or gobs of glass must be uniform in size.

3. The glass must reach the mechanical device at a temperature suitable for forming.

4. The feeding must be adjustable and at such a speed as to synchronize with the operation of the device.

5. If the better quality of product is manufactured, the marks made by the cutting off or forming of the gob must be eradicated.

There are several feeders on the market that meet these requirements, and many others in the process of development. The success of the feeders has made it possible to make many machines entirely automatic. Some of these feeders employ refractory material for paddles or plungers that operate in troughs or cylinders of the same substance. The sucking or vacuum method uses an iron mold for the gob receptacle. By the use of a bait, other processes draw the glass in the form of cylinders, sheets, rods or tubes over rolls or through dies. One recently patented process allows the glass to flow out of the front of a tank, dropping between rolls that form it into window glass of any desired thickness.

Iron molds were introduced as an improvement of the old hardwood blocks. Molds made of cast iron are of three classes: iron, blow molds, paste molds and press molds. Iron blow molds are used if the design or figure on the exterior of the glass article does not permit of its rotation around a vertical axis in the process of blowing. Most of the molds of this class are made in two or more parts. The joints of the sections are reproduced on the glass and care is taken in the designing of the decorations, and the making of the mold to hide these joints or marks as far as possible.

Paste molds are so called from the coating of charcoal and adhesive substance used in covering the interior, or working surface, of the mold. Only such shapes are made in these molds as will permit of rotation. They can be made in two or more sections without the reproduction of joint seams, as the rotating of the glass in the mold removes them. Paste molds were developed from the old maple or apple blocks, and like them cooled by dipping in, or spraying with water. Up to the time of our present machines, bottles (without lettering), lamp chimneys, electric light bulbs, balls for light shades, and blown tableware were the more important articles made in these molds. The development of the paste used has made it possible to make a product as free from tool marks as the best mechanics were able to make by the "off-hand" method.

The manufacture of pressed glass required a new class of molds. The forcing of a plunger into a gob of hot glass replaced the stream of air from a blower's pipe. Molds of this class consist of two essential parts, the mold proper, or die, and the plunger. Other parts such as bottom plates and rings are often used to facilitate the operation of the mold. Hollow articles made in this class of molds must always be of such a shape as will permit of the removal or release of the plunger. Because of this the ingenuity and skill of the designer and mechanic has often been taxed in the manufacture of certain articles.

The metal used in the manufacture of molds and other devices for forming glass is a very important factor in their successful operation. Molds were originally made of just cast iron. The analysis of the iron that entered the casting was of little concern to either the foundryman or the glass manufacturer. Progress demanded a better product and much time and expense have been used to develop castings that would meet the requirements of molds. Steel, nickel, chrome, vanadium, victor metal and monel have been used as alloys with standard pig iron, with varying success. To date, the best all around castings for molds are made of pig iron and returns of the proper analysis. While the working conditions severely tax any metal used for molds, there is a great opportunity for development. An ideal mold iron must produce the article as free from marking as that produced by the "off-hand" process, and as rapidly as the machine will charge and remove the glass from it.

Just at this point it might be well to mention a machine recently put on the market for performing most of the labor in making molds. In many instances this machine will reduce costs.

Without doubt the development of the various bottle-making machines has given glass manufacture its greatest impetus during the past thirty years. Up to 1890 there were practically no power-driven machines in use for shaping glass. The first partially automatic machines were designed and used for making thin blown tumblers, chimneys and similar articles.

Prior to this, the only machine used was the hand lever press. While the press has been greatly improved as to details, the process is the same. Today we have fully automatic machines for making lamp chimneys, lantern globes, gas and electric light shades, tumblers, electric light bulbs, cane glass, tubing, window glass and various forms of pressed shapes. A single man, with these machines and their automatic feeders, carrying-in devices and lehrs, is producing what it formerly required from six to forty workers to do. The time allotted for this paper does not permit further details as to their individual operation.

In the early days glass was reheated for forming and fire polished in the openings of the furnace or tank. Glory-holes or large ovens were then introduced and various devices are now on the market for accomplishing similar or better results. There are portable glory-holes, automatic fire polishing machines and automatic finishing machines. A machine has recently been developed that shapes and rolls a thinner edge on a blown tumbler than can be uniformly accomplished by the "off-hand" process.

Carrying-in devices or conveyors are of two principle types, conveying on endless chain flights or pushing by endless chain on a smooth surface. The common method of placing the product in the lehrs is to push the articles off the carrying-in device on to the lehr pans. These devices have

replaced many boys in the glass factory and are made a part of the blowing or pressing machine, the operator of which looks after the entire unit.

The tempering of glass is a very large subject and I will only touch on the high places. The first systematic tempering was done in ovens. These ovens were heated and after the glass was placed on shelves or in pans, the doors were sealed and the temperature gradually reduced through a predetermined period of from twenty-four to seventy-two hours. The doors were opened and the glass removed. This was a sure but slow process. The old-fashioned pan lehr from fifty to seventy feet long and five feet wide was its successor.

Automatic machines brought out the continuous type which, with its modifications as to operation and construction, is at present the last word for the average manufacturer. There is still some difference of opinion as to the construction of pans and the kind of chain to use.

The use of raw gas for fuel has necessitated in most factories, a change from the open fire lehr to the muffle type. Lehr manufacturers vary considerably in their ideas as to the construction of this type of lehr. One design may prove successful in one plant and, if slightly modified to meet another glass manufacturer's conditions, proves a disastrous failure. Length over-all, width, height, size of flues and fire boxes, heat control and method of firing are far from being standardized.

The tempering of his products is a mighty serious problem to the average glass manufacturer. From natural gas at ten cents and less to thirty cents and over for raw gas is a big jump.

Mr. Collins'[1] paper last year demonstrated from tests made that a heat 25 degrees less than the annealing temperature required a lehring three times as long. An ideal lehr should have perfect heat control.

The use of pyrometers and polariscope, or commercial strain detectors, are of great value in the successful operation of any type of lehr.

An initial heat lehr has been developed and has successfully operated for the tempering of tumblers. This lehr is built close to the machine and the glass enters it immediately after the last operation. The lehr is only about four feet wide and twenty-five feet along. Fuel consumption is low as pyrometer readings run 800° F and under.

Considerable improvement has been made in the grinding and decorating of glass ware. From the grinding of tumblers to the polishing of plate glass, new equipment has been introduced.

Grinding mills have been developed that are semi-automatic. Edge grinders, for tumblers and similar hollow ware, that are semi-automatic and real producers, are on the market. Air brushes for color decorating, needle etchers and acid etching machines, are helping the glass manufacturer to keep down his labor costs.

[1] Collins, *Jour. Amer. Ceram. Soc.*, **4,** 335 (1921).

In the large factories you will find conveyors for the distribution of the finished product. Electric and gasoline small trucks, as well as over head monorail systems are performing a good work.

As one manufacturer, whose plant was fitted with automatic equipment, remarked, "Our raw material and fuel enters the north end and our finished product goes out of the south end. If we had a catsup factory on our south side, the bottles could be filled as they went out of the door; and no hand has touched them except for inspection.

Yet with all these improvements, in 1914 glass-making ranked 13th in percentage of labor cost with respect to the value of the product. Government reports for the year 1917 show labor to be 40.6 per cent in the manufacture of glass.

We have just entered upon a period of automatic glass manufacture, and there is a wonderful opportunity for the progressive equipment builder. He will, with the coöperation and assistance of the glass factory man, attain results beyond our present conception.

Simpson Foundry & Engineering Co.
Newark, O.

KILN MANIPULATION IN RELATION TO SCHOOL AND STUDIO POTTERY[1]

By Frederick H. Rhead

ABSTRACT

A suggestion for a chart to be used in connection with the firing of studio and school kilns.

The use of the chart makes it possible to record the time element, amount of fuel, and the temperature curve.

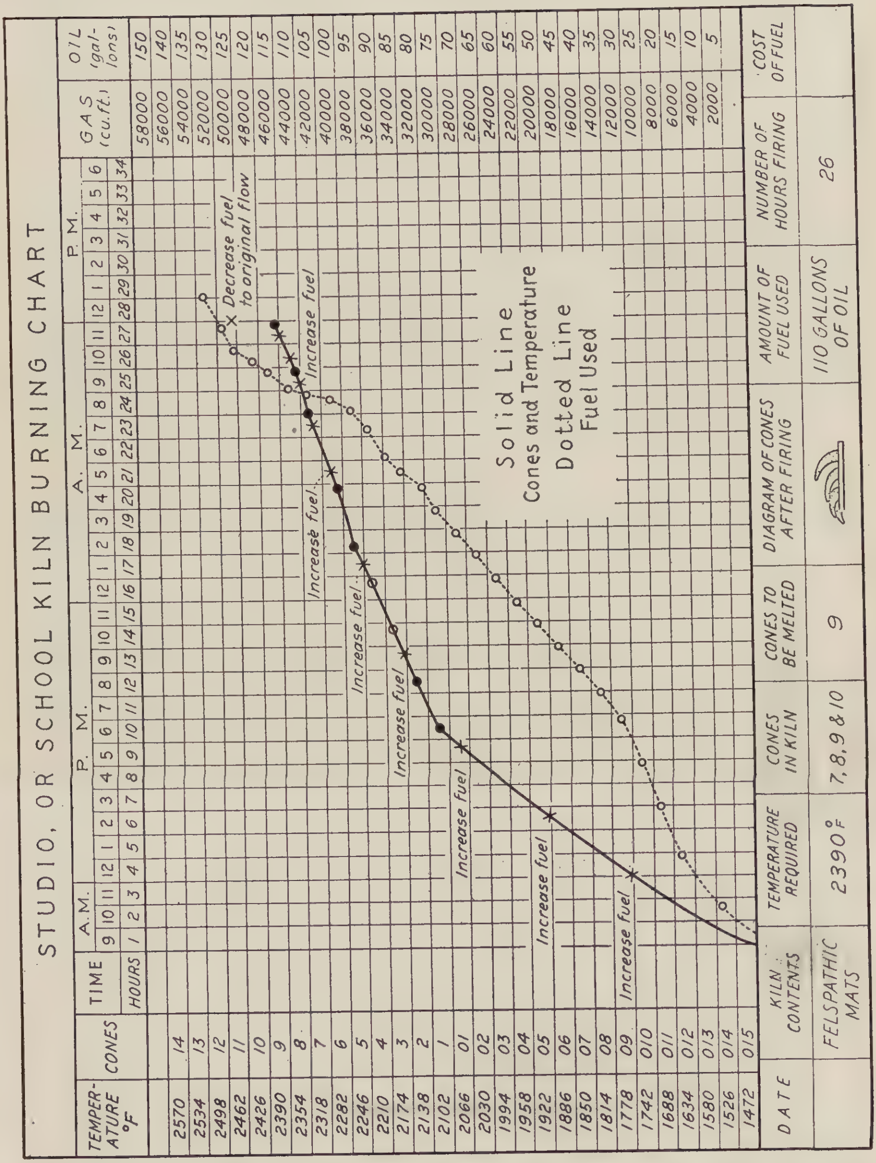
Introduction.—*This discussion is concerned chiefly with methods* for recording temperatures, the fuel consumption and time element in connection with the burning of studio or school kilns.

There are many studios and schools using pottery kilns where the available funds or appropriations will not permit the installation of mechanical recording equipment, consequently there should be some inexpensive yet practical method of recording every kiln firing. Very few schools or studios use charts to record the various kiln burns, and as a result it is very difficult to standardize the firing process.

Various Types of Recording Instruments.—There are a number of recording instruments. Among these may be mentioned the pyrometers of the Le Chatelier type directly registering and recording the temperatures by means of platinum or base metal thermocouples; the Leeds and Northrup optical pyrometer registering the temperature by comparing the color of the heat of the kiln with the color of the filament of a specially

[1] Art Division, St. Louis Meeting, Feb. 28, 1922.

calibrated electric light bulb; or the prismatic Wedge optical pyrometer. But only the larger schools and studios can afford even the minimum cost of a hundred dollars necessary to purchase and install any of these types.



For the average work with the smaller kilns, the Seger cones are most satisfactory, but it seems obvious that if the kiln firing operations are charted, better control and more uniform results will be obtained.

The Use of the Chart.—The studio worker and the school instructor may acquire the utmost confidence when executing most of the pottery processes, but it always seemed to the writer that most of them balk at the kiln. While kiln firing is an uncertain operation at best, it is the one process that does need the confidence and all the knowledge at the disposal of the operator. The mere lighting of the kiln, the passage of time with the periodic increase of fuel for a particular burn is not enough to insure regular and uniformly repeated results. If each firing can be approximately charted, the operator will possess information which will be found most valuable for future work, and in addition the firing operation can be regulated to a much greater extent than is commonly possible.

The chart outlined gives a fair idea of this method of recording the firing process. It shows the time element, actual time of lighting and finishing the kiln, amount of fuel consumed with the periods of increase, and in the lower part of the chart a diagram of the cones after the kiln is finished.

If air is used, either in connection with oil or gas, a column recording the volume or pressure can be added at the fuel end of the chart. Under such conditions the operation of the kiln, when reducing atmospheres are required, can easily be regulated.

It is a simple matter to rule up a chart for each firing, or blue prints could be made. If I were a manufacturer of portable kilns, I would supply these charts with the kiln.

This system would also be valuable in factories possessing no pyrometer equipment. The number of large plants possessing no filed records of their kiln operations is surprising. No matter how skilful or reliable the kiln fireman may be, it would seem to be good business to have some system where the past and present practice of this most important process may be subject to investigation, supervision and regulation during the burning period.

COLLOQUIUM ON FELDSPAR AND FELDSPAR GRINDING[1]

Note by Editor:—In the discussions to date there has been less on quality and specifications than is desired. Eventually there will be a consideration of relative merits of the so-called hard and soft or the more easily fusible and refractory feldspars for general ware, porcelain insulators, floor tile, glazes, etc. Such questions have already received the attention of ceramists, potters and tile manufacturers, whose definite and quite different individual preferences are based on extensive manufacturing experiences. Facts and experiences concerning all of this will be brought out before this colloquium is concluded and before a definite schedule of research is determined. For the present, attention is directed

[1] Continued from *Bull. Amer. Ceram. Soc.*, **1**, 78 (1922).

to methods of milling and effect of each process on cost and quality. A poor grade of feldspar for many requirements is expensive at any price while for several purposes a lower quality of feldspar is as good. The cost, however, should be accordingly lower.

There seems to be a market for each sort of feldspar produced but neither the user nor the producer, generally speaking, seem to have definite knowledge of the requirements for every sort of ceramic ware. It would seem that definite specifications, together with permissible range in variation, would be desired by both parties and it is to this desideratum that this informal colloquium is being directed, taking one step at a time. For the while, attention seems to be directed more on economical methods of milling; but in this there must be a consideration of the quality of feldspar produced, the effect of the grinding process on quality as well as on cost.

Is there a preference for water-ground feldspar and why? Can 160-mesh feldspar be produced as economically and of as good a quality by the dry as by the wet?

What are the considerations, in general, for using wet or dry, conical mills, tube mills or batch mills?

What dimensions of mills are most suitable for given purposes and why?

In a continuous or closed circuit, with wet or dry grinding, how much of the discharged material is returned to the mill for regrinding and how can this be regulated?

What is the most economical equipment as to quality and cost per ton (or ton per hour), for intermediate grinding and why? Give the facts and figures.

To what extent does character of feldspar rock affect such considerations as the foregoing, what are these characteristics and in what manner and degree are they effective?

What are the significant factors causing the variation in production in the following citation from a letter from Joseph P. Rodgers?

"A very considerable difference in the fineness of feldspars is due to the character of rock ground. Our Hardinge mill (grinding wet) will produce forty-five hundred pounds per hour when we are working on the product of a certain quarry but it will not produce in excess of thirty-five hundred pounds per hour when grinding the product of another quarry. When an average quality of rock is being crushed, our production is two tons per hour. Tests of this material made yesterday (May 25, 1922) disclosed the fact that 61.5% of it will pass 180-mesh brass cloth, using the wet test, 66% will pass 120-mesh cloth and 95.5% will pass 40-mesh. All of the material taken from the mill passes through an 18-mesh screen.

By N. W. Stern (San Francisco):[1]—In the first place, I want you to

[1] May 24, 1922.

realize that I am in a different position from the millers in this country. We are potters and own our own feldspar deposit and do our own grinding. We have an enormous deposit and use great care in the grinding of our materials.

Mr. Kiliani of the Hardinge Co. came to this coast and interested me in a Hardinge mill. He guaranteed a certain capacity and certain fineness. On the strength of his guarantee, I ordered the mill. I followed his instructions implicitly, making all the changes he suggested at various times. All of these resulted in naught. The mill now reclines on the junk pile.

Our present flow sheet is a very simple one. We put the rock on a crusher of the old chaser type with six-foot stone and with twenty-inch space. From here it is conveyed to the Emeric separator. The fines are removed and the coarse goes into a 5 $\times$ 22 tube mill lines with Silex. The discharge of this mill goes on to the same conveyor that comes from the chaser. In this way we avoid iron and have but the one hauling, that is, putting it on to the chaser. Before we erected this plant we had a chaser, a screen and a 6 $\times$ 10 Patterson type batch mill, which gave us nine to ten tons of material a day, which, up to that time, was sufficient to keep us operating. This worked admirably but the cost of operation was a little higher than on our present scheme.

Mr. Ladoo has, in my opinion, made a serious mistake in recommending the Hardinge mill for dry grinding. This mill is used in ore dressing and is, as I understand it, a great success when grinding wet, but for dry grinding it is an absolute failure and I should think Mr. Ladoo would go into this matter more thoroughly with the people who have attempted to use this mill for dry grinding, before recommending it for this method.

Since we are grinding feldspar only for our own use, our grinding practice differs somewhat from that which it otherwise would be. We have had no trouble with mica as all our feldspar is used in the pottery where the mica is removed on the lawn. As a matter of fact most of the mica comes out in fairly large pieces at a separator as it comes from the chaser, thus it is not ground to a fine powder. Such as is reduced to fine powder is for the large part removed when the body mix is lawned in the pottery.

We have absolutely no iron in our feldspar as the only thing that touches our material is the chaser stone and the Silex lining of the tube mill.

I agree with Mr. Ladoo in that the millers have been grinding a very inferior grade of feldspar due to the fact that the accessible quarries have previously been picked of all good feldspar and today the feldspar that the potters receive is a very undependable grade. That is the main reason that we have purchased our own deposit and are doing our own grinding.

A few dollars a ton on feldspar is very insignificant compared to the quality of merchandise in which it is to be used.

The potters have often said that the beginning of winter is the best time to lay in a stock of feldspar as the mills are all piled with feldspar during the summer and they select the best feldspar first, leaving the inferior grade to grind later in the winter, so that just before the quarries open you get nothing but the cull.

By R. B. Ladoo:[1]—In my discussions previously submitted, I have expressly stated and repeated in several places that the flow sheet suggested was a composite of various machines and methods in actual use in feldspar mills today.

Even if no mills of this type were now used by feldspar companies their success, under almost identical conditions in other industries, would justify a trial by feldspar companies. Innovations always require a period of experiment, trial and adjustment, and my flow sheet was offered as a basis for experiment derived from the successful experiences of other companies.

I am aware that Hardinge mills have been tried unsuccessfully in the past by several feldspar companies. As I have already pointed out in a previous communication, the Hardinge mill was designed for the wet grinding of metallic ores and until recent years the problem of dry grinding of non-metallic minerals was given little attention. Mills designed for wet grinding were tried unsuccessfully for dry grinding. More recently, the company's attention has been given to the problems of dry grinding and changes have been made in the Hardinge mill. For example, in some instances where a six-foot Hardinge mill would be used in wet grinding, an eight- or ten-foot mill is now recommended. Furthermore, as I have previously pointed out, some feldspars, particularly those high in quartz, may not be as well adapted to this type of mill.

It should be noted that the success or failure of any method of continuous dry grinding of feldspar is dependent upon the development and use of a suitable method of sizing the milled product and returning the oversize for regrinding. This is true whether the mill used is the Hardinge, the Marcy, the Allis-Chalmers, or any other type of either short or long continuous pebble mills.

At present the best method of fine sizing seems to be by the use of some form of air separation, of which there are a number of types. Air separation has been used for many years. The problem of fine sizing is not peculiar to the feldspar industry, but the identical problem is found in the grinding and sizing of many other non-metallic mineral products. The loss of fine materials by floating off in the air to which you have referred

[1] May 24, 1922.

can be reduced to a minimum by the use of tight housings, as has been done in similar installations in other industries.

In my flow sheet I made no provision for hand-sorting prior to intermediate grinding, as I had previously outlined in my paper a method of crushing and hand sorting to be used either at the mine or at the mill. The place to do hand-sorting is preferably at the mine, so as not to incur the expense of hauling waste material to the mill.

I would again call your attention to the fact that I have proposed no system which is radically different from any now in use, but I have merely suggested as a basis for experiment a composite flow sheet made up from parts of mills found most successful in actual practice.

By V. A. Stout (Hardinge Company):[1]—I have been extremely interested in Mr. Ladoo's article on "Conditions in the Feldspar Industries" and the discussions it has called forth. My interest comes naturally from a close association and study of the industry, as the representative of a company selling a continuous grinding machine which has been more or less successfully introduced into that industry and which Mr. Ladoo was kind enough to mention favorably. However, it is not from the viewpoint of a representative of the company selling that mill that I wish to enter this discussion, but rather as an engineer, who has made a careful study of its grinding problems.

There are too many questions involved to warrant my doing anything more than touch them briefly. I shall, however, give some little space, if I may be permitted, to the so-called closed circuit system of grinding, the character of the product produced, and the economies of its operation. I feel that Mr. Ladoo's criticisms of mining methods have been rather well covered by previous discussions.

Mr. Rodgers in his discussion on the milling end suggested one difficulty about this so-called new process, which I think needs answering before I get into the main body of my discussion. He stated that some potters refused to buy feldspar which has been crushed in a crusher, of course, because of the iron contamination. Two methods are possible to meet this difficulty. One is by means of a magnetic pulley following the jaw crusher to take out the iron introduced into the feldspar when crushing it. This is, perhaps, the surest way but it is somewhat complicated and might be objected to as being an added expense. The second way is not so sure, but it has proven successful in actual operation. This is the use of the highest quality manganese steel for the jaws of the crusher. One company using the system described in Mr. Ladoo's article with manganese steel jaws on the crusher have been able to sell their feldspar on the potter's own test at a top price in the market.

[1] May 26, 1922.

And now as to the quality of the feldspar produced by this system. Quality must be judged from the viewpoint of marketability and that means the potter's specifications. These cover freedom from iron contamination and fineness. In the system described there is an absolute and positive control of the fineness. Either the Hummer Screens or the Emerick Air Separator are easy of adjustment and positive of their control of fineness. These machines are working today in connection with Hardinge Mills to produce feldspar which is being sold to the ceramic trade. There is no oversize on 140-mesh in the product of these machines and who among the grinders of feldspar can say that he never has had trouble with oversize in his product even after it had been ground the customary length of time in batch tube mills.

We have already discussed the question of iron contamination from the crusher. There can be no iron contamination from the Hardinge Mills which are lined with Silex, and use Danish flint pebbles as grinding mediums. Careful and exhaustive tests show that neither the Hummer screen nor the Emerick Air Separator will contaminate the finished product with iron. Since the results of these tests have been checked by the actual operation of commercial plants selling ground feldspar to the ceramic trade, we can rest assured that no iron contamination can harm the marketability of the product.

Having assured ourselves that the product of this closed circuit system of grinding is right and that it is marketable, let us examine the economies of operation of this system when compared to the practice of intermittent or batch grinding preceded by chaser mills for the preliminary breakdown. Without betraying a trust by mentioning any names, we can give below an actual comparison of costs between the two systems.

The following figures give in detail the costs of the continuous system of closed circuit grinding in Hardinge mills with control of the finished product by means of air separation just as outlined in Mr. Ladoo's article based on a capacity of 3 tons per hour of feldspar ground through 140-mesh, $98\frac{1}{2}\%$ through 200-mesh.

Power

	H.P.
1—No. 4 Jaw Crusher (preliminary break)	20
1—Elevator	3
1—10″ x 16″ Crusher (finished crush—through 3/4″ ring)	15
1—16″ Belt Conveyor (crushed feldspar to bins)	2
1—Elevator (first Hardinge mill to screens)	1
1—8′ x 36″ Hardinge Conical Pebble Mill	50
1—8′ Hummer Separator (preliminary grind through 30-mesh)	2
1—12″ Belt Conveyor (to secondary bin ahead of finishing mill)	1
1—8′ x 48″ Hardinge Conical Pebble Mill	75
1—12″ Belt Conveyor (finished bins to cars)	1

1—Elevator (to air separator)	1
1—14′ Emerick Air Separator (to control finished product)	20
Transmission Loss	2
	193

193 H.P. hours at $1^1/_2$ c per H.P. hours divided by 3 tons per hour 9.65c

Repairs

1. Hardinge Mills—		
(a) Pebble Wear 3 lbs. per ton @ $1^1/_2$c	4.5c	
(b) Lining Wear $^1/_2$ lb. per ton @ $2^1/_2$c	1.25c	
(c) Wear on Mill Parts (feeders, gears)	2.0c	
2. Hummer Separators—Screen		
Life 30-mesh separation 6 mos	0.6c	
Other Repairs	0.5c	
3. Elevator and Conveyor Repairs	10.0c	
4. Shafting, bearings, bolting, etc.	3.0c	
5. Emerick Air Separator	10.0c	
6. Jaw Crushers	2.0c	
7. General Plant Maintenance	1.0c	34.85c

Oil and Grease

Motors or Engines	4.0c	
Crushing and Grinding Machinery	4.0c	8.0c

Labor

5 men — 50c per hour	83.0c	
1 Engineer or Electrician — 75c per hour	25.0c	108.0c
Total Cost per Ton of Ground Feldspar	$1.6050	

Costs in plants of the intermittent type will vary with their locality which affects the items of labor and power, but we think that the figures given below may be taken as fairly representative and at least they have the power and labor costs figured on the same basis as that used above. This plant using chaser and batch tube mills with a total capacity of 60 tons finished in 24 hours had costs as follows:

Power @ $1^1/_2$c per H.P. hour	20c
Labor	120c
Repairs	160c
Oil and Grease	10c
Total Cost per Ton of Ground Feldspar	$3.10

I hear at once the cry go up from the feldspar grinders: "My costs are not that high." I am, of course, not in position to judge individual costs in individual plants scattered over the country. Perhaps it would be unfair to label the above costs of the intermittent system as "representative." However, the costs of the continuous system are given in

detail so that all may study them and compare them with their costs of grinding feldspar. The difference between the two sets of figures is so marked that even a 20% variation downward for the intermittent system of grinding would still show a big saving in favor of the continuous system. There seems little question that a feldspar meeting the specifications of fineness and freedom from iron contamination can be produced by the continuous system of grinding in Hardinge mills in closed circuit with screens and air separators at a most reasonable cost which is probably very much lower than costs of the older systems of chaser mills and batch tube mills.

By Everett Townsend:[1]—Our plant is a very small one and we have only been running it since January 1. Our pebble mills are six feet eight inches in diameter and make twenty-seven revolutions per minute. The feldspar from the chasers is put through $^1/_4''$ mesh wire. The mill is run $6^1/_2$ hours. We put 3500 lbs. of feldspar to a charge and use 4700 lbs. of pebbles of a uniform size. This grinding gives us feldspar fine enough to go through 120-mesh wire lawn, with less than 1% residue. In testing this through the lawn, we mix it with water and run it through the lawn in the slop state.

Our six months observation and experience in grinding "Rock Spar," a pink (not the white variety) orthoclase feldspar, is as follows:

We have tried to contract for what we term the "Crystal Spar," which in its pure state is practically free from free silica; our classification being that we cannot see any quartz with the naked eye. Some miners say that it is permissible to have from 5% to 10% of free silica in the feldspar and still call it selected quality. The trouble is, when you contract for selected feldspar, there creeps in a lot of rock that runs too high in quartz.

An empirical test, using a sample from a grinding of the purest crystal rock, and a sample from a grinding of rock from the same mine having a content as high as 10% of quartz showed equal fusibility. Hence, for tile the writer could not observe any different results between the bodies made from the pure "Crystal Spar" and the feldspar with the 10% of free silica.

With more than 10% of quartz content, say 25% or 30%, there are a great many impurities appearing in the rock, such as tourmaline and sulphide of copper. We have not observed a great deal of tourmaline but there is in some of the mines a great deal of sulphide of copper, which is impossible to cob out. Before putting in our own mill, we had a very costly experience with ground feldspar from a rock containing a large quantity of this impurity.

[1] May 30, 1922.

We have noticed that as the vein gets poorer it runs up against "Granite" walls. We have received some quantities of this in our shipments. As I understand it, this "Granite" rock is feldspar, quartz and mica. We have had a small lot of this class of rock come in some of our carloads but, of course, have thrown it out. We have not made a special grinding of this "Granite" rock so that we do not know how it would test by itself. We are breaking all our rock feldspar up by hand before putting it under the crusher, so that we can cob out and throw away any rock that is not up to the standard we desire.

We can get the pure crystal rock, with practically no quartz showing in the rock, providing we pay the price for it. This is the class of feldspar we are now using. But the miners should get a good price for this class of feldspar, and the grinders also. There, of course, must be a market for the No. 2 grade, free from metallic impurities, or otherwise the miners would have to get a much higher price for their selected feldspar. Therefore, if the buyers want the best, they must pay the price. If they buy at a low price, they will certainly get a No. 2 grade of feldspar.

By V. A. Stout:[1]—There has been sent around to the various people interested in the discussion of Mr. Ladoo's paper on "The Grinding and Milling of Feldspar," a colloquium in which there are certain questions asked and which it would be desirable to answer, particularly on the part of the miller, and since the writer is in better position perhaps to do this than are others in the profession, he is again entering the discussion to clear up certain of these points.

The first question asked was as to the preference of water-ground feldspar, and why. This part of the colloquium I would leave to the potters, since they can answer this question better than I can. The balance of the question, however, "Can 160-mesh feldspar be produced as economically and of as good a quality by the dry as by the wet process," the answer is that it undoubtedly can. However, the main difficulty with the wet process is the drying of the material after it has been ground to pass through 160-mesh. It is a whole lot easier to drive off the surface moisture from feldspar when it is in the lump state, say one or two inches, than when it is pulverized to pass through 160-mesh. This very fine material requires an elaborate equipment for settling out the water and bringing it down to a moisture content where it can be finally dried in specially designed dryers to eliminate any iron contamination. All of which is extremely expensive and a very difficult process.

The second question is "What are the considerations, in general, for using wet or dry conical mills, tube mills or batch mills?" The main consideration should, of course, be the quality of the finished product,

[1] Received May 26, 1922.

and the cost of producing this product. That system which gives the best quality of finished feldspar, that is, with the greatest marketability, the most economically, is undoubtedly the system which would meet the universal test of desirability of milling equipment for the entire industry. Into the cost of grinding must, of course, enter the drying of material and the power consumption, which is the major expense of milling. Of secondary importance also is the labor and attendance.

The next question is "What dimensions of mills are most suitable for given purposes, and why?" This question is certainly answered by the direct statement that in other industries the batch mill, tube mill, and conical mill have all been tried out competitively, and it is the results of these tests that must control the choice of the miller who is figuring on the installation of a grinding plant.

The next question is "In a continuous or closed circuit, with wet or dry grinding, how much of the discharged material is returned to the mill for regrinding and how can this be regulated?" The answer to this question is that the more material that is returned to the mill, the more efficient will be the grinding, and it is attempted in certain industries today to crowd up this material coming back as a reject to three or four times the initial feed going to the mill. This, of course, calls for a short length of mill through which the material can be rushed with only a relatively small amount of grinding done in each passage, but ultimately by building up the process a very large capacity with a low power consumption. This is the secret of closed circuit grinding and it has been developed to its highest fame in the mining industry in wet grinding mills, where circulating load or return of oversize from the screens or classifiers amounted in one instance to thirteen times the initial feed, and in a great number of instances to five or six times the initial feed. Normally, we would say that if as much oversize is returned to the mill for regrinding as is fed to the mill, then the efficiency of the system will be fairly well established.

The next question is "What is the most economical equipment, both as to quality and cost per ton (or ton per hour), for intermediate grinding, and why? Give the facts and figures." We take this question to refer to intermediate grinding of material through 90-mesh, which is known as the No. 2 product. As a manufacturer of equipment, we do not feel it consistent with our attitude in this discussion to describe what we consider the most economical equipment for this particular type of grinding. However, we can say that the closed circuit arrangement of a large diameter, short length pebble mill, with screens, has proven very satisfactory in a great number of instances and undoubtedly shows a much lower cost per ton for the finished material, as against batch grinding, even with the relatively shorter length of grinding necessary to produce this intermediate product. Our records show that $2^1/_2$ tons per hour of feldspar

can be finished in a Hardinge mill, operating with screening equipment, to 90% through 100-mesh, for a power consumption of 50 h.p. or 20 h.p. hours per ton, one man being in attendance, and the cost for pebbles, lining and general maintenance of the entire plant not exceeding 25 cents per ton.

The next question is "To what extent does character of feldspar rock affect such considerations as the foregoing and what are these characteristics, and in what manner and degree are they effective?" Insofar as the grinding is concerned and its costs, we have not found that any variation in character of the feldspar has any material effect upon the cost of grinding.

In answer to the final question of the colloquium, which gives a quotation from a letter by Mr. Jos. P. Rodgers, in showing the variations in capacity of a Hardinge mill, wet grinding, from 4500 lbs. on a certain feldspar produced from a certain quarry, and 3500 lbs. from another quarry, there is only one answer and that is that the one feldspar is harder to grind than the other. There is, of course, bound to be a certain variation from day to day in the relative hardness of feldspar and this hardness means that more energy must be consumed in grinding it, since in a given mill you only have a given output of energy; then naturally, the capacity of that machine will vary slightly. There are unquestionably different hardnesses of feldspar which must be taken account of in grinding, but all of which can be readily solved by simple and inexpensive tests, which, in the case of the machinery manufacturer with proper knowledge, can be very carefully predicated in advance.

N. W. Stern brought up certain points, which I think must be answered. The mill to which Mr. Stern refers is a 6-ft. diameter by 48-in. length of cylinder Hardinge Patent Conical Pebble Mill, sold him in 1916. At that time we did not know as much about grinding feldspar as we know today, but even then we knew enough to recommend that this mill should be operated in conjunction with suitable separating device to control the fineness of the finished product, and that the reject from the separator should be returned to the feed end of the Hardinge mill for further grinding. This recommendation was made to Mr. Stern.

Mr. Stern stated that at the start he did not care to install these separators, but would try the mill out without them, leaving their installation until a later date. These separators were never, to my knowledge, installed and their not being installed is the fundamental reason, as far as we can determine, for the failure of this Hardinge mill, which produced in the discharge from the mill 30% to 40% coarser than the 160-mesh required by Mr. Stern. If, however, the separators had been installed, this 30% to 40% oversize would have been taken out and sent back to the mill for further regrinding, the separator being adjusted so that the

product would all have been of the desired fineness and the installation made a success.

The capacities of conical mills, in grinding feldspar, are all based upon closed circuit grinding where a fairly uniform and fine product is desired, for experience has shown that operation in this manner produces the desired results at much less cost than if operated any other way.

Discussion by Harlowe Hardinge:[1]—Speaking from a manufacturer's view-point, there are a number of conditions which must be met which the mill man would not foresee. Some of these conditions I will outline in this communication. First of all, there are certain business ethics involved in giving out information which has been given to us in confidence, and it is these business ethics which have caused us to withhold concrete information which we have in our files because we have agreed not to publish or send out broadcast certain very conclusive information which we have received. There is little good in giving concrete facts if you cannot show where and how these facts were obtained. In short, our hands are tied.

Many times we have tried to get certain facts released so that we could prove to some of our business acquaintances the statements which we make involving the operation of our equipment, but in almost every case we met with an emphatic refusal.

We ran up against the very unsatisfactory condition of second-hand machinery dealers getting hold of Hardinge mills, which come on the market from time to time, and selling them to companies without regard to the work they are to perform. The main burden then devolves upon the purchaser to make the mill suit his conditions and unless he knows something about operating a mill of this type, he may get into trouble (or it may be a ball mill instead of a pebble mill). Hence, every once in a while we run up against a so-called unsatisfactory mill, and upon investigation find that it is supposed to do work which we would never have recommended had we an opportunity to advise.

Often we come against the difficulty of a slightly different size of mill; for instance, we build an 8-ft. diameter by 22-in. cylinder, 8-ft. diameter by 30-in. cylinder, and 8-ft. diameter by 36-in. cylinder. There is very little difference in the lengths of these cylinders. Hence, a second-hand dealer would say that he has an 8-ft. diameter by 22-in. cylinder mill. The Hardinge Company may have recommended an 8-ft. by 30-in. mill, and there being only 8-in. difference in the cylindrical length, his mill will do just as well. As a matter of fact, an 8-in. difference in the cylindrical length sometimes means as much as 30% difference in capacity. The purchaser does not condemn the second-hand dealer but he does the Hardinge mill.

[1] June 3, 1922.

Another point—in fields like the ceramic industry, which have a tendency to great secrecy, some companies, in order to retain their secrets or steer their competitors away from methods they employ, send out derogatory reports of the equipment they use, not that they are doing anything unethical, but they will make a point that whenever their equipment is not running right up to the minute, they will take pains that the outsider hears about it but he does not hear about the other 360 days of successful operation which enables him to keep his costs below his competitor.

These conditions which we run up against are in my opinion the chief cause for the delay of the general acceptance of our mill in the ceramic industry, for we know what the mill has done, having been on the ground ourselves and having seen the mill operating under average conditions. We have checked up the costs and found them to be so much lower than the average that it is difficult for us to comprehend, until we reflect upon the conditions as mentioned above, why this system has not been generally adopted long before this.

By Harlowe Hardinge:[1]—Every plant, with which I am personally acquainted, where we are grinding feldspar, is operating dry, with the exception of a 5-ft. mill installation at the Dental Supply Co., York, Pa., where a very high grade of feldspar goes into the manufacture of false teeth and where the fineness must be regulated very carefully. Such installations as at Erwin Feldspar Co., the old installation at Clinchfield Products Co., Bedford Feldspar Co., Mount Eagle Feldspar Co., the new installation at Golding-Keene Co., and a number of other installations, are all grinding dry.

The references of where the Hardinge mill has "failed" are all on account of old methods of operation which took place a number of years ago, when we did not know as much as we do now.

Mr. Rodgers says that Mr. Ladoo exaggerated the capacity of the mill and that the most he could ever put through an 8-ft. diameter by 22-in. cylinder Hardinge mill was 4,500 pounds per hour and that the 30-in. mill has an advertised capacity of 10% greater than the 22-in. mill. Mr. Rodgers' statement in reference to the old style mill is absolutely right but he fails to take into account that the design of the Hardinge mill has been greatly improved and we have also learned more about its operation. By changing the type of feeder, and also the inlet and discharge of the Hardinge mill, we have found the capacity to be very materially increased and as we operate these mills in an entirely different way than heretofore, Mr. Ladoo's estimates are not exaggerated.

As a concrete example of what has been done within the last two years

[1] June 9, 1922.

in grinding, I will cite our installation at the plant of the Lytle Coal Co., Minersville, Pa., which is dry grinding a very hard anthracite coal. Although coal is not the same as feldspar, the general operation is very similar. The Lytle Coal Co. were casting about for a machine to grind anthracite coal to a fineness of about 90% through 200-mesh. The mills tried out previously had proved too expensive from a standpoint of upkeep. From previous operation on similar materials, even taking into account our old operation of grinding feldspar, we recommended one of our mills to do one ton per hour to a fineness of 90% through 200-mesh. Changes in the method of operation were made which increased the capacity of this mill to $2^1/_2$ tons per hour. Another design of mill, having the same diameter as the first but changed in other respects, maintained a capacity of 3.67 tons per hour average over a month's operation. Often the capacity ran well over 4 tons per hour, the product being better than 92% through 200-mesh, the mill operating in conjunction with an air separator. This is four times as much as originally estimated and as a result this company recently ordered two 7-ft. diameter by 36-in. cylinder Hardinge Ball Mills to complete their installation.

The Canada Cement Co. is grinding a cement clinker, known to be the hardest clinker in the country. They installed our large 10-ft. mill to grind approximately 17 tons per hour, but are actually averaging over 25 tons per hour.

DISCUSSION ON "DERRY FELDSPAR QUARRY"[1]

By Raymond B. Ladoo:—The feldspar deposit described by Mr. Davis seems to be unusual, both in size and in the purity of the feldspar which it contains. While it is true that, in some districts, there occurs but one large deposit of unusual merit, surrounded by other deposits smaller and less pure, this condition does not seem to prevail generally.

In several of the large feldspar producing districts of the United States a number of deposits, nearly equal in size and purity, have been worked and other deposits discovered and held in reserve which seem to give promise of equal value.

Until the market price of feldspar reaches a point which will encourage the very thorough and systematic prospecting of less accessible areas, both in the United States and Canada, the presence or absence of other large deposits of feldspar cannot be definitely proved.

By H. Ries:—I have read Mr. Davis' paper with much interest. The general region in which the Derry quarry occurs has been proven to contain some most interesting deposits of feldspar. In the famous Richardson

[1] Davis, *Jour. Amer. Ceram. Soc.*, **5**, 294 (1922).

quarry, east of Godfrey, worked for a long period, there was a differentiation similar to that described by Davis. There the quarry showed a very large mass of deep pink feldspar in the center of which was a huge horse mostly of quartz.

The Richardson feldspar emphasized a curious fact, even more forcibly than does the Derry, that the cream or bright pink of feldspar is not necessarily due to iron oxide.

THEORY OF PLASTICITY AND POSSIBLE COMMERCIAL APPLICATION

A colloquium on this topic was intended for the Annual Convention. George A. Bole delivered an opening address, the substance of which is in his paper.[1] F. P. Hall[2] presented a summary of methods for measuring plasticity. Time did not permit extending the discussion at the convention as was planned. Hence it has been continued by correspondence.

The Editor was asked to open this informal discussion which, if done editorially, would require a review of the literature and an impartial presentation of the several theories that have been advanced. This seems to be unnecessary inasmuch as references will be made as the discussion progresses. The Editor would rather enter as a free lance, without editorial restrictions, and the following discussion is written with this freedom.

Discussion by Ross C. Purdy:—My first approach to this question of plasticity in 1904 was from a reading knowledge of the several experiments and theories reported in the literature. I accepted the very plausible theories that the "clay substance" was somewhat soluble in water and that clays contained alumina, silica and iron hydrates which would reverse back and forth from the gelatinous state (as when precipitated from solution) to dry powder. The dry powder of these hydrates was a "gel" which would adsorb enough water to again render their mass gelatinous. I had the conception that the portions of clay, which were too small to be distinguishable under an ordinary microscope, were the prime factors in rendering the mass as a whole plastic and that it was these small particles which, through some process of molecular disintegration and hydration, went into solution, thus making a gelatinous-like mass similar to freshly precipitated aluminum hydroxide. The physical phenomena of Brownian movement and of flocculation and deflocculation were thought to be evidence of ionization reactions between the salts

[1] "Mechanism of Plasticity from Colloid Standpoint," *Jour. Amer. Ceram. Soc.*, **5**, 469 (1922).

[2] "Plasticity of Clays," *Ibid.*, **5**, 355 (1922).

in solution and the products of partial disintegration of the "clay substance."

At that time we understood it clearly that, when speaking of colloids, reference was made to state of matter rather than substance, *i. e.*, the distinction between crystalloidal and colloidal state was without reference to substance, it being supposed that all substances could be produced in either state. It was not clear, however, what state or condition a substance must be in to be distinguished as colloidal or how this transformation could be effected.

The picture had at that time of colloidal condition was exemplified by the physical properties of precipitated aluminum hydroxide, silicic acid and glue as the "gel" state, and these same things by some process converted to solutes as the "sol" state, the transition from the "sol" to the "gel" state being that of gradual precipitation from solution.

Dr. Paul Rohland[1] gives these same misconceptions which we had of colloids in 1903 to 1905. If needs be, during the progress of this colloquium, I will give an exposé of Rohland's treatise to show the very far-fetched and ill-grounded conceptions that were generally held at that time.

It was with these misconceptions regarding colloids in clays that I started work with the Geological Survey of Illinois in the fall of 1905 and it was because these conceptions would not plumb with proven chemical and ceramic facts that I had to search for evidence independently of the orthodox colloid chemistry of that time.

I came early to the conclusion that one of the reasons that chemists had been lead astray, regarding colloids in clays, was the terminology used, and hence, in the discussions with Mr. Ashley,[2] I was not only making constructive criticisms of the conceptions advanced by him but also of the terminology used.

One paragraph[3] of my discussions of Mr. Ashley's paper reads as follows: "To claim that the clay particles must be wrapped about by a colloidal coating, because the clay responds in like manner in one test with colloids, is of the same order in logic as claiming the existence of an element 'phlogiston' which all chemists did prior to the discovery of oxygen by Lavoisier in 1774."

Dr. J. W. Mellor,[4] in 1921, or twelve years later, writes: "Clays have qualities which might be predicted from the known properties of matter in the colloidal state. It is, therefore, assumed that clays contain x per cent of colloidal matter possessing qualities like those possessed by the clay itself." This explanation recalls A. Baume's "saline matter" and the

[1] "The Colloidal and Crystalloidal State of Matter."

[2] *Trans. Amer. Ceram. Soc.*, **11**, 530 (1909).

[3] *Ibid.*, **11**, 586 (1909).

[4] "On the Plasticity of Clays," *Trans. Ceram. Soc.*, **21**, I, 92 (1921).

"terra pingua" of the mediaeval chemists. The plasticity of clay has been attributed to both these imaginary substances. Indeed, just as in mediaeval times, every chemical process which was not understood was explained by an assumed terra pingua or phlogiston, so now we are inclined to attribute to the colloids every quality of clay which is not understood. Nevertheless, I believe a modified colloidal hypothesis gives the best working explanation of several properties of clay, even though it must be added that we have not progressed very far in advance of the eighteenth century. Calling the same things different names is not getting along very fast.

I have never denied the existence of colloidal matter in clays.[1] I have questioned, and still question, if plasticity of clays follows from any such process as described by Ashley[2] when he says "effect of the grinding is to expose fresh surfaces of these minerals upon which the water has a hydrating effect, forming colloidal hydrates."

An idea of the length to which the reasoning without facts went at that time, can be had from the following:[3] "The difference between the normal and the preheated clays is due to coagulation, the material has become set, to use the language of the colloid investigators, and irreversible, as far as practical purposes are concerned."[4] "He explained the change produced on the basis that the organic or inorganic colloids are shriveled up and rendered either temporarily or permanently unable to take up water and assume their former jelly-like condition."

"The chief colloidal materials[5] to be considered in clays are silicic acid, aluminum and ferric hydroxides, and the organic emulsion colloids."

"In the light of colloid chemistry,[6] we may consider these minerals in contact with water as tending toward a state of equilibrium. At the point of contact there is the tendency of the mineral to go into solution; but the action is slow, hence the colloid condition has a chance to develop"—— "at the same time new mineral combinations are being formed and part of the oxides produced go into the sol state and may later become gels. Where alumina and silicic acid sols are being formed at the same time, they tend to coagulate one another to gels. Other colloid sols have a similar effect on one another"——. "The finer the grain of the clay, the more chance there is for colloidal material to form"——. "The longer the clay particles are subjected to the solvent action of water, the more colloidal material is formed."

All of these quotations (and many more of the same sort could be quoted

[1] *Trans. Amer. Ceram. Soc.*, **11**, 590 (1909).
[2] *Ibid.*, **12**, 810 (1910).
[3] Bleininger, *Ibid.*, **12**, 506 (1910).
[4] Orton, *Ibid.*, **13**, 774 (1911).
[5] Davis, *Ibid.*, **16**, 76 (1914).
[6] *Ibid.*, **16**, 79 (1914).

from the *Transactions* of this Society and from the literature) are in line with the fallacies taught by Dr. Paul Rohland in 1913 and earlier, and which are yet being advanced by some physical chemists.[1]

Definition of Sol.—Bancroft[2] says "Sufficiently finely divided particles will be kept in suspension in a liquid indefinitely by the Brownian movement, provided coalescence and the resulting agglomeration are prevented. Such a colloidal solution is called a sol."

The portions of clay suspensions which will not clear after weeks of standing are an example of coarse sols comprising discrete particles which do not coalesce, plus salts adsorbed and in true solution, and water.

Definition of Gels.—Again quoting Bancroft, "When the colloidal particles agglomerate and precipitate, the precipitate is called a gel." There is no reference in the foregoing definition of "sol" to hydration, hydrolysis or anything other than suspension. In case of clays it is a suspension of discrete particles. The only portions of a clay that approach the "sol" state are the ultra fine particles, and the only "gel" then are these fine particles agglomerated. As a matter of fact one can wash out all the fine particles produced by thorough disintegration of the clay, and the coarse particles of hydrous silicate of alumina will, as a rule, exhibit the same plasticity as when the fine particles were admixed. The fine particle portion will not be plastic, cannot be dried and rewetted or likewise worked as clay. Furthermore, the coarse particles remaining will flocculate and deflocculate with electrolytes as before. In other words, neither the plasticity nor the behavior of clays with electrolytes are dependent on or are much influenced by that portion which would come under the definition of "sol" and "gel."

The terms "sol" and "gel" have application in the physical chemistry of clays only in a far-fetched sense; they are pictorial terms and not really applicable to the whole clay mass; they give misconceptions.

Rather than "sols" and "gels" I plead for the use of the common sense and truthful terms "deflocculated" and "flocculated." They leave out of consideration the solution ideas and refer only to dispersion and precipitation of discrete clay particles without any hydration, hydrolysis, coalescence or other physical chemical alterations in composition.

Clays do not form typical colloidal solutions; only a small portion of any clay roughly approximates such and really is not essential to plasticity. If "sol" and "gel" are not applicable to the discrete particles which will not stay in suspension but will nevertheless flocculate and deflocculate, why use such foreign language?

[1] Moore, Fry and Middleton, *Jour. Ind. Eng. Chem.*, **13,** 527 (1921); Harry N. Holmes, "Laboratory Manual of Colloid Chemistry," 104 pp. (1922).

[2] W. D. Bancroft, "Applied Colloid Chemistry," 161 (1921).

Here are two sentences,[1] "Clays can be obtained so finely divided that they can make true colloidal solutions. Colloidal clay belongs to the class known as 'suspensoids' and is reversible, that is, the particles can be dispersed in water or thrown out of colloidal solution by means of suitable electrolytes."

Within the extreme meanings of these words, no question can be raised as to their accuracy. A small portion of plastic clay can be obtained that approaches "true colloidal" solution but the only clay (Bentonite) in which a predominating proportion approaches anywhere near the true colloidal solution *state* has low bonding strength and does not add to the plasticity or bonding strength of any clay or ceramic mixture. It has adhesiveness but lacks cohesiveness. Any or all portions of any clay, the coarser grains of which are high in "clay substance" (as determined chemically), will be about as plastic and have about as high strength as the clay had before removal of the portions that approach "true colloidal solution."

The clause quoted from Schurecht reading "the particles can be dispersed in water or thrown out of colloidal solution by means of suitable electrolytes" is true in reference to such colloids as ferric hydroxide, which can be had in all stages from clear solution to gelatinous mass, but in reference to coagulation of suspended discrete particles of clay of sizes too large to be classed as colloidal, this clause gives an exaggerated picture of the case, and gives emphasis to the portion of clay which is non-essential to plasticity.

Accuracy in science is essential and so scientific statements must be, not only as to wording but also in possible interpretation by those for whom the statements are written. It seems to me nonsensical to use terms that are only approximately true in reference to the smaller portion of the clay and that too to the portion which is non-essential to the development of plasticity. It certainly gives a wholly incorrect vision of clay to say "clays can be obtained so finely divided that they can make true solutions."

It certainly does not plumb with the whole truth to say that "colloidal clay belongs to the class known as suspensoids and is reversible," for the portions not classed by size of their particles as colloidal are also reversible in the sense that they can be flocculated and deflocculated. Then too most of the fine particles that are correctly styled as colloid are at the coarse end of the colloid scale.

I grant today, as I did in 1910, that the fine clay particles come under the classification of colloid, but since the size of particles in clays are discrete and do not coalesce, and since the majority of them in most plastic clays are too large to be styled colloidal, why not characterize them as

[1] H. G. Schurecht, "The Use of Electrolytes in the Purification and Preparation of Clays," Bur. Mines, *Technical Paper* **281**, 1922.

particles (which they all are), rather than as colloids. Why give the whole collection of particles, comprising the clay, the characterization of the minor portion, especially when the colloidal portion are particles of the same sort as those of the major portion of the clay.

Since we strive to have the language we use convey most exactly our conceptions, I propose the following substitution of words when discussing clays: (1) deflocculated for sol; (2) flocculated for gel; (3) clay suspension for colloidal solution; and (4) deflocculated for dispersed.

"Set Gels."—What in clays can be styled "set gels?" Does this refer to dehydrated clay particles? If so, why the use of the words "set gels?" When clay is subjected to increasing heat treatment, the water and volatile gases are driven off, making more than a change in *state;* it is a change in substance and the dehydrated clay particles dehydrated are not of the same substance they have been. This is not a case of "set gel."

Colloids in Clays.—The colloids in clay effecting plasticity are discrete particles of hydrous silicate of alumina some of which are bundled together into coarser particles that resist disintegration by water. When a clay is made up of various sizes of "particles," the coarser ones of which are cemented agglomerates of small particles, the mass as a whole will exhibit that which we call plasticity. The larger bundles of particles will have the same adsorptive power per surface exposed and react physically with electrolytes to the same degree as will the small discrete particles. Hydration and hydrolysis of the clay substance breaking down into hydrates of alumina and silica are not necessary to an explanation of flocculation and deflocculation.

Cause of Plasticity.—In general my ideas are as stated in 1909.[1] "Plasticity is the result of purely physical conditions and properties—adsorption, solution, molecular attraction and high surface tension." These cause the particle when wetted to hold a water saturated film. For the mass to exhibit plasticity, the particles must not be separated one from the other beyond the range of molecular attraction, one with the other, which range is sufficient to permit each to retain its maximum water envelope. Experiments have shown that the volume of water required to render a clay mass plastic is equal to the volume of water required to fill the pores when the formed mass has been dried, plus the water required to give each and all particles (or bundles of particles) its maximum water film. This salt solution film is the "slippery medium" and when the mass is dried these salt coatings are the cementing agents and when subjected to heat treatment they are the sintering media. Flocculation and deflocculation occur in response to relative difference in surface tension of the excess water, *i. e.*, water in excess of the total re-

[1] *Trans. Amer. Ceram. Soc.*, **11,** 588 (1909).

quired to render the mass plastic, and the surface tension of the water film. I called this a difference in potential, and my conception is that clay particles flocculate when the potential of the water envelopes is less than that of the excess water and they deflocculate when the potential of the water envelopes is greater. The greater surface tension of water envelope not only results in deflocculation but also requires less excess water to give the clay mass the same degree of plasticity. When the mass is in sufficient amount of water to allow free movement of particles, a condition known as "slip," the particles will flocculate as the surface tension of the excess water is increased. This explains why a small portion of salt deflocculates (it all goes to the films by adsorption) and excess of this amount of salt again flocculates.

I have given a colloid theory of plasticity in terms that describe exactly what happens. My explanation of the cause of "happenings" may contain some errors but the terms used mean just that and only that which I intend. They are not misleading.

NOTE ON THE RELATION OF THE STRUCTURE OF CLAY GRAINS TO THE PLASTICITY OF CLAYS

By H. G. Schurecht

It is undoubtedly true that the fine-grained kaolinite aggregates, or "bundles" of clay particles as Mr. Purdy calls them, exert an important influence on the plasticity of clays. It has been shown by microscopic examination[1] that most clays consist of aggregates of fine-grained kaolinite particles rather than coarse individual ones. The proportion of the clay which is readily deflocculated does not represent all of the extremely fine clay particles, since a certain portion is usually present in certain aggregates which are not affected by electrolytes.

The writer found that by agitating many clay slips, in which the clay grains were composed of fine-grained kaolinite aggregates which were not affected by electrolytes, for different periods of time, they became finer-grained upon increasing the time of shaking. With some clays a maximum degree of fineness is not obtained after continued shaking for three days. Since these aggregates may be disintegrated by agitation, it is evident that they are only loosely cemented together. Such grains impart plasticity to clays, while the firmly cemented aggregates found in flint clays which do not disintegrate by agitation in water do not impart plasticity to clays. All other things being equal, clays consisting mostly of loosely cemented aggregates of fine-grained kaolinite are more plastic than those composed of coarse crystalline kaolinite particles or firmly cemented aggregates of

[1] "The Microscopic Examination of the Mineral Constituents of some American Clays," *Jour. Amer. Ceram. Soc.*, **5**, 6–7 (1921).

fine-grained kaolinite. The presence of these loosely cemented aggregates of fine-grained kaolinite also explains why some of the clays still have considerable plasticity after the fine suspended clay is removed, while others like the Spruce Pine, N. C., kaolin, which is composed almost entirely of coarse crystalline kaolinite particles, have very little plasticity after the fine suspended material is removed.

In addition to the cemented aggregates of fine-grained kaolinite, clays also contain flocculated aggregates of fine-grained kaolinite which exert an important influence on the plasticity of clays. The writer has shown[1] that by adding 1–2 per cent alkali to plastic clays, their plasticity is greatly decreased, due to deflocculation, and their dry strength increased, while acids function oppositely. All other things being equal, those clays having the largest proportion of flocculated fine-grained kaolinite aggregates are more plastic than those having larger proportions of deflocculated clay particles and *vice versa*. By flocculated clay particles the writer means those which are capable of being readily deflocculated by the addition of alkalies.

The writer found[2] that it is possible to deflocculate a larger percentage of the extremely fine kaolinite particles, *i. e.*, below 0.0001 mm., which are considered colloidal, from ball clays than from kaolins. This would indicate that the flocculated aggregates of fine-grained kaolinite particles in the ball clays are composed of finer-grained kaolinite particles than those in the kaolin. It is, therefore, probable that the greater plasticity of ball clays as compared with kaolins is partly due to the fact that the flocculated aggregates in ball clays are composed of finer-grained kaolinite particles than those in kaolins.

It was also found that the properties of ball clays are changed much more by the addition of electrolytes than are the properties of kaolins. For example,[3] the writer found that by adding 1.5 per cent NaOH to a ball clay in the plastic state, its dry strength was increased about 400 pounds per square inch, while the dry strength of Georgia kaolin could be increased only about 75 pounds per square inch by this treatment.

Mr. Purdy states in the opening discussion that by speaking of the colloidal clay particles[4] the writer referred to that portion of clay which is non-essential to plasticity. Since the writer has found that the plasticity of many clays is affected by the initial alkalinity or acidity of the clays and since those clays having the larger proportion of extremely fine-grained

[1] "The Use of Electrolytes in the Purification and Preparation of Clays," U. S. Bureau of Mines, *Tech. Paper* **281,** 28–29 (1921).

[2] "Sedimentation as a Means of Classifying Fine Clay Particles," *Jour. Amer. Ceram. Soc.*, **4,** 818 (1921).

[3] U. S. Bureau of Mines, *Tech. Paper* **281,** 28–29 (1921).

[4] *Ibid.*, **281,** 5 (1921).

kaolinite particles are more affected by electrolytes than those composed of coarser individual particles, it seems that the fine particles in clay do play an important part in the plasticity of many clays, although it is not the only factor influencing plasticity.

The fineness of grain of the particles in the loosely cemented aggregates of fine-grained kaolinite in clays is also important and undoubtedly has an important influence on the plasticity.

In summarizing, the writer wishes to suggest the following factors which influence the plasticity of clays. It is assumed in the following that all other things are equal except the two factors cited in each case.

1. Clays composed of loosely cemented aggregates of fine-grained kaolinite are more plastic than those containing firmly cemented aggregates of kaolinite particles (*i. e.*, aggregates not disintegrated by agitation with water).

2. Clays composed of loosely cemented aggregates offine-grained kaolinite are more plastic than those composed of coarse crystalline kaolinite particles.

3. Clays composed of flocculated aggregates of fine-grained kaolinite are more plastic than those composed of deflocculated particles of kaolinite.

4. Clays consisting of aggregates which are composed of extremely fine-grained kaolinite particles are more plastic than those in which the aggregates are composed of coarser kaolinite particles.

5. Clays composed of flocculated aggregates of fine-grained kaolinite are more plastic than those composed of cemented aggregates of fine-grained kaolinite.

In the above comparison the writer has selected the extreme cases in which only two factors vary to simplify the comparison, while as a matter of fact, all of these factors may exert their influence on most clays in different degrees, hence causing the widely different properties of clays in their plastic state.

In conclusion, the writer wishes to state that the above statements are not positive conclusions, but merely opinions based upon a limited amount of laboratory work, under which condition the writer was asked by Mr. Purdy to discuss this subject.

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DISCUSSIONS ON "NEW DEVELOPMENTS IN OXY-CHLORIDE STUCCO AND FLOORING"[1]

By MAX Y. SEATON:—The paper on "New Developments in Oxy-Chloride Stucco and Flooring," by Shaw and Bole, is unquestionably of interest to the chloride industries, for it deals with investigations on the

[1] Shaw and Bole, *Jour. Amer. Ceram. Soc.*, **5**, 311 (1922).

two basic raw materials employed in the manufacture of products having a value of between ten and fifteen million dollars yearly. It appears to the writer, however, that the paper is to some extent misleading in presentation. The authors premise that the two main defects in the current oxy-chloride practice are high cost and poor quality of the products, and present certain data on methods and materials which are expected to remedy these conditions; yet on the basis of their own figures no cost reduction will result from one of their proposals, while the other, although of a more promising nature, when considered in the light of past investigations and of recent practice does not offer any immediate hope for either cost reduction or quality improvement.

These authors first propose that calcium chloride be used to replace magnesium chloride in oxy-chloride cements. Study of the table submitted shows that when calcium chloride is used, attractive strengths are only obtained in neat mixes or in mixes far higher in magnesium oxide content than those used in the field. Neat oxy-chloride cement is never used in practice, and the fact that a calcined magnesite mixed with calcium chloride sets firm and hard while a similar neat cement using magnesium chloride is not as attractive physically is without meaning from a practical standpoint. The increase in magnesium oxide, required in all of the calcium chloride cements described, far more than offsets any cost saving brought about by substitution of calcium for magnesium chloride.

The second proposal, that magnesite be replaced by dolomite in oxy-chloride cements, is of somewhat more interest. This subject has, in fact, engaged the attention of investigators for many years. Patents to Clark[1] in 1881, to Billwiller[2] in 1915 and to Mitchell[3] in 1918 show the trend of thought in this direction. The decomposition of dolomite on heating and the development of free lime have been followed by various investigators, notably by Kallauner,[4] while the quantitative effect of free or active lime on the properties of oxy-chloride are discussed quite fully in a previous paper by the writer.[5] The patents above particularly refer to the regulated burning of dolomite, but other methods for the recovery of its magnesium oxide content have had much attention. The separation of magnesium from calcium in burned dolomite rocks is, of course, common practice in the insulating magnesia industry, and is carried on also in the commercial manufacture of magnesium chloride. More recently Schurecht[6] and Eyoub[7]

[1] Brit. Pat. 1720 (1881).
[2] U. S. Pat. 1129060 (1915).
[3] U. S. Pat. 1273110 (1918).
[4] *Chem. Ztg.*, **37,** 1317 (1913).
[5] *Chem. and Met. Eng.*, **25,** 270.
[6] *Jour. Amer. Ceram. Soc.*, **4,** 558 (1921).
[7] *Eng. & Min. Jour.*, **112,** 619 (1921).

have studied the leaching out of lime by water from burned dolomite. All these methods are intended to give a product eventually suitable for use in the oxy-chloride industries.

Shaw and Bole mention a special method of preparing dolomite by which the occurrence of free lime is avoided, but give no details of process and no intimation as to probable cost. Laboratory preparations of specially treated dolomites using at least three different methods have been extensively studied under the writer's direction, but although all such methods produce a product of fair quality, the production cost outlook is by no means clear. The future of commercial production of dolomite for the oxy-chloride industries must depend on the economies of the process and of the transportation situation, for it must not be overlooked that a burned dolomite carries two parts of inert filler to one part of magnesium oxide and must be freighted to point of consumption. A cheap and satisfactory filler is usually available locally to an oxy-chloride manufacturer.

Messrs. Shaw and Bole's remarks on the tests of their prepared dolomites made by the Dow Chemical Company, although unquestionably correct when these tests were made in 1920, cannot be applied today to commercial magnesite production. In water resistance tests a 50% recovery is not considered passable today. The plant specifications of one producer[1] require in fact a recovery of 100%, a value which neither of the dolomite products reported approach.

Oxy-chloride cement failure, traceable to faulty magnesite, has unquestionably often occurred in the past, but modern methods in calcining practice have eliminated the majority of such difficulties. A failure of oxy-chloride products in the field may be due to faulty ingredients, faulty proportions or faulty workmanship. Only when great attention is given to each factor is success assured. The principles of aggregate proportioning in oxy-chloride cements are but little understood, and failure frequently results from the use of improper mixtures even when all the ingredients used in the mix are of satisfactory quality.

By Robt. D. Pike:—In discussing Messrs. Shaw and Bole's paper my remarks will be based largely upon some experimental work with which I have been connected. Although this work was principally concerned with magnesite we did some work with a dolomite from Owens Lake, California, having the following analysis:

Insol.	0.55
Fe_2O_3	.00
Al_2O_3	.15
CaO	30.40
MgO	22.60
Ig. Loss	46.04

[1] The Sierra Magnesite Company, Porterville, California.

We first produced a calcined product containing 17.5% water soluble lime. This material, when mixed with aggregate and gauged with $MgCl_2$ sp. gr. 1.19, was entirely worthless as a cement. We then prepared this same dolomite so that when all of the $MgCO_3$ was calcined there was present less than 1% of water soluble lime. This latter material was ground, mixed with Ottawa standard sand in the proportion of 3–5 by weight, and gauged with the same $MgCl_2$ solution. When normal consistency was reached the ratio $\frac{MgCl_2}{MgO}$ was 0.349. Incidentally this dry mix contains the same per cent of MgO as a 1–2–5 mix, made up from 85% calcined magnesite, the figures referring to the respective weight percentages of calcined magnesite, Silex, and standard sand. This mix gave a cement having the following properties:

Initial set	2.11 hrs.
Final set	3.26 hrs.
Tensile strength	24 hrs., 379 lbs. sq. in.
Tensile strength	7 days, 569 lbs. sq. in.
Tensile strength	28 days, 589 lbs. sq. in.

The test for water resistance was crude, but indicated that this property was satisfactory.

These results seem to confirm the findings of Messrs. Shaw and Bole insofar as the latter relate to cements gauged with $MgCl_2$ and it appears likely that a pound of MgO in a properly prepared dolomite will be as valuable as a pound of MgO in calcined magnesite, at least when we consider the lean mixes employed in stucco manufacture, but we cannot accept this as a final conclusion applicable to actual practice, until we have gathered a considerable additional amount of data covering not only laboratory but field tests.

We only experimented with the use of $CaCl_2$ to a limited extent, but our results were not favorable to its use. The results obtained with $CaCl_2$ by the authors of this paper are surprisingly good, but even so they do not indicate that this cheaper material will eventually replace $MgCl_2$ because it gives inferior results in all but the neat magnesite mixes, which latter are not commercially practical. The action of these mixes is puzzling and holds interest from a theoretical view-point.

One of the main conclusions of our experimental work was that the principal independent variable affecting the quality of calcined magnesites is heat treatment, the term implying a combination of the factors, temperature of calcination, temperature to which the material is raised immediately after calcination, and the time of residence of the material in the calcining furnace. Incidentally the significance of the first mentioned factor is doubtful, because calcination is an endothermic process which proceeds actively at a given temperature, and the last two factors are probably

the significant ones in determining the properties of the finished material. It has also been noted that with the purer grades of magnesite, the so-called calcining temperature, *i. e.*, the temperature observed in the calcining zone of the kiln, should be between 900° and 1000° C to give the best results, all things considered.

It occurs to me that these facts possibly bring out a serious objection to the Shaw-Bole process, in which the temperature of calcination and the heat treatment of the product must be governed by consideration of the dissociation pressure of calcium carbonate, and cannot on this account be over 700° C, using the authors' figure, whereas experience with pure magnesites containing little or no Fe_2O_3, and in this important respect comparable with the dolomite, indicates the desirability of a calcining temperature of over 900° C, which would render the dolomite worthless because of the presence of free lime.

As the authors have pointed out in the final analysis economic consideration will govern. In this connection I have developed a simple formula for showing the relative value of magnesite and dolomite based upon the assumption that the value of unit weight of MgO is the same in both.

$$C_1 = \frac{M_1F_2 - M_2F_1 + M_1C_2 - V(M_1 - M_2) - P(M_2 - M_1)}{M_2}$$

The symbols with some approximate values follow:

M_1 = proportion MgO in dolomite = 0.27.
M_2 = proportion MgO in magnesite = 0.80.
C_1 = cost producing ton of dolomite ground ready for use at plant.
C_2 = same magnesite.
F_1 = freight rate per ton on dolomite from factory to point of use.
F_2 = same for magnesite.
P = cost of packages per ton.
V = value of aggregate at consuming point.

To compare the economic value of these two materials take a hypothetical case. Suppose that—

C_2 = \$30 (California Magnesite).
F_2 = \$16
P = \$ 2
V = \$ 3
F_1 = \$ 3

Then C_1, the cost of producing dolomite to put it on a parity with California magnesite, assuming that the former must stand only \$3 per ton freight, as compared with \$16 for the latter, would be \$12.50 per ton. In short, under the assumed conditions the cost of producing the specially calcined dolomite, ground in bulk must be \$12.50 per ton to be on a parity with magnesite.

The experimental work to which I have referred was a coöperative research between United States Bureau of Mines and Northwest Magnesite Co. into the preparation and properties of caustic burned magnesia carried out during 1920–21 at the Berkeley station of the Bureau.

By G. A. Bole: We found the optimal temperature for calcining dolomite to be between 700° and 800° C at which temperature the dissociation pressure of the calcium carbonate is considerable, as pointed out by Mr. Pike, but so long as the calcination is carried out in an enclosed space the calcium carbonate will not dissociate until the temperature reaches nearly 900° C—the temperature at which the dissociation pressure reaches one atmosphere.

All of our semi-commercial (ton lots) calcinations were carried out at a temperature of 750° C and none of them showed as much as 1% free lime. This was, of course, due to the fact that the material was under an atmosphere of carbon dioxide.

The cost of calcination lay well within Mr. Pike's estimate of $12.50 per ton.

By H. G. Schurecht: In the utilization of dolomite for oxy-chloride cements, the presence of free calcium oxide seems detrimental as Bole has pointed out. The writer, under the direction of Mr. R. T. Stull, experimented with dolomite cements prepared by calcining dolomite between 770–800° C and produced an inferior cement which never did get very hard. By calcining the dolomite at a lower temperature in an atmosphere of CO_2, as Bole recommends, the formation of free lime is prevented. However, this product has approximately 71.2 per cent $CaCO_3$ which exerts no cementing action and contains only 28.8 per cent of cement.

The writer conducted experiments on dolomite cements by calcining them to 1000° C, *i. e.*, to decompose both the $CaCO_3$ and the $MgCO_3$. The CaO was then converted to $CaSO_4.xH_2O$ by treatment with $MgSO_4$-$7H_2O$. The product was then recalcined which converted the $CaSO_4.xH_2O$ into Estrich plaster and hence a cement was produced in which both a magnesia oxychloride and Estrich plaster reaction were involved.

In a second series of tests the dolomite after calcining at 1000° C was ground with kaolin calcined at 700° C in a proportion as follows: 1 mol. of Al_2O_3 $2SiO_2$ to 1 mol. of $CaMgO_2$. The free lime in this case combined with the clay to form a water resisting cement. Blast furnace slag and basic hearth slag were used in the place of calcined kaolin with good results.

These cements differ from the type described by Bole and although the experiments were not carried through to completion they appear promising since the cementing properties of the calcium is taken advantage of instead of allowing a large percentage of inert $CaCO_3$ in the cement.

DISCUSSION ON "FIRE CLAYS OF THE EASTERN COALFIELD OF KENTUCKY"[1]

By A. M. Miller:—It is an admirable presentation of the subject, summing up well the results of previous investigation, and giving additional facts brought out by the recent examination of the field by the author of the paper.

If I may be permitted to defend my own views as to the age of this flint fire clay of that region, I would present the following facts for consideration.

1. In passing northeast along the western margin of the eastern coalfield in Kentucky, the Chester series becomes thinner and the upper members of it, especially, are apt to drop out, the Pottsville then resting on lower members of the series.

2. The exposures of the fire clay along the north fork of the Licking, one of which is the Blair's Mill exposure, is southwest of the Carter County exposures. They are evidently all of the same bed despite the fact that the quality of the clay as a refractory material may differ in the two regions.

3. At one place, the Blair's Mill exposure, the clay is undoubtedly interstratified with Chester, though only a few hundred yards away it is immediately overlaid with the Pottsville conglomerate.

4. One single case of interstratification of the bed with Chester would seem to fix its age as Chester, no matter if anywhere else to the northeast it is immediately overlaid with the Pottsville. For this laying down of the Pottsville on lower and lower beds of the Chester (and indeed in the absence of the latter on lower beds of the remainder of the Mississippian) is just what is to be expected from the thinning of these upper beds of the Mississippian as the formation is traced to the northeast.

DISCUSSION ON "MICROSCOPIC STUDY OF GROUND COAT AND COVER COAT ENAMEL REACTIONS"[2]

By R. R. Danielson:—Mr. Geisinger has made a very interesting as well as a valuable contribution to the literature on enameling. He has brought out very nicely the relation of the structure of the enamel to its ability to remain intact under the compression to which ordinary steel enamels are subjected. In our study of gray ware enamels we have noted that those enamels which show blistering from an excess of salts in the dipping operation do not usually develop fish scaling although they normally do scale.

We have also found that enamels which are under great compression

[1] H. Ries, *Jour. Amer. Ceram. Soc.*, **5**, 397 (1922).
[2] E. E. Geisinger, *Ibid.*, **5**, 322–37 (1922).

because of their low coefficient of expansion as compared with that for steel, will shiver and flake off in large patches when overfired although when properly fired they develop only typical small scales. It would, therefore, seem that the shivering Mr. Geisinger describes is an exaggerated development of the fish scale which occurs in the form of the typical scale when the enamels are properly fired. Another factor which may have caused shivering in Mr. Geisinger's work is the steel which for his purpose is of comparatively heavy gauge, thus tending to place the enamel under still greater compression.

By E. P. Poste:—It is very gratifying to realize that the rather general observations, reported by the writer,[1] have stimulated a sufficient interest on the part of the author of the present paper to bring forth a much more elaborate application of the study of enamels under the microscope.

We note that the author uses the terms "shiver" and "fishscale" as referring to different types of trouble. In general, we are of the impression that the term "shiver" has been used in connection with glazes applied to earthenware or other bodies, while the word "fishscale" has been used in connection with enamels, more particularly those applied to steel, and we are quite certain that many enamelers when using the word "shiver" think of it as synonymous with "fishscaling."

Apparently the author uses the word "shivering" to refer to the flaking off of the upper coat of enamel, leaving in a very porous condition some enamel adhering to the steel.

We are not criticizing this usage of the terms but feel that the author's point of view should be thoroughly understood in considering the paper.

The observations of the writer check the statements of the author as regards the general nature of the burning of enamel. The early stages of the process involve the solution of unfused material, while in the latter stages and certainly in over-burning, certain reactions take place which give rise to the formation of bubbles. It is probable that with the average steel enamel no one point in the burning involves the entire absence of unfused material and bubbles, so that the best compromise which may be adopted as a normal burn involves the presence of small amounts of unfused material and also the presence of a relatively small amount of fine bubbles.

In general we feel that the study of chips of enamel in cross section is a very fruitful field, not only as a matter of determining the conditions existing in the enamel but the possible causes of lack of adhesion of the enamel to the metal.

[1] Poste, "Enameled Surfaces under the Microscope," *Trans. Amer. Ceram. Soc.*, **19**, 146 (1917).

ACTIVITIES OF THE SOCIETY

Atta Boy!

A fisherman on the bank of a river was asked by a passer-by, "How many have you got?" "Wa-al," he drawled, "when I gits another, I'll hev one."

The membership record this month is a multiple of this story. When we get another personal membership we shall have just *twice* as many as last month, and when we get another corporation member we shall have just *three times* as many as last month. Prolonged applause.

The Terra Cotta Tigers produced a wicked wielder of the willow this month in A. F. Hottinger. This wonder of Chicago actually brought in seven of the eleven new Corporation Members, single-handed. His record and that made by Salisbury, with his six White Wares Corporations two months ago, stand alone. The managers confidently expect that the Enamel Eagles and the Refractories Regulars will be ace-high next.

Bowman 2nd is beginning to put something on the ball besides the cover and he has brought in two Corporation Members, while Cruikshank and Stanger each scored with one.

Personal memberships are well scattered. J. S. McDowell, Tillotson, and W. S. Williams, all of the Pittsburgh Pill Pounders, have two runs apiece. Pence, Rhead, Orton, Ross, Wilkins, Hansen, Wilson, Danielson, Van Schoick, Watts, Gibson, Sweely, Turk, Worsham, Steinhoff, and Wenning, each scored once. With those who were received at the Secretary's office direct, this makes a total of 25 personal and 11 Corporation members.

We will now rise and stretch before the seventh inning. Then, let 'er go again.

New Members Received from June 1 to July 13

ASSOCIATE

Beidler, Edward R., 32 Toronto St., Toronto, Ont., Can., Gen. Supt., Interlocking Tile Co.

Bennett, A. Lee, 6512–44th Ave., S. W., Seattle, Wash., Student, University of Washington.

Chapman, William B., 50 Church St., New York City, President, Chapman-Stein Furnace Co.

Cooley, M. B., Hickory, Ky., President, Cooley Clay Co.

Crane, Raymond E., 220 Alleghany Ave., Kittanning, Pa., Vice-Pres. & Gen. Mgr., Eljer Co., Ford City, Pa.

Davies, B. H., 3528 Paseo, Kansas City, Mo., Chemical Industrial Engineer, Dickey Clay Products Mfg. Co.

Gammon, Marshal E., 1677 E. 93rd St., Cleveland, Ohio, Representative, "Brick & Clay Record."

Hain, Veit A., 6058 Harper Ave., Chicago, Ill., District Mgr., George J. Hagan Company.

Harlow, Justin E., 155 E. Superior St., Chicago, Ill., Chief Engineer, M. H. Detrick Co.

Hartzell, John L., 1708 Kenneth Ave., Arnold, Pa., American Window Glass Co.

Insley, Herbert, U. S. Bureau of Standards, Washington, D. C.

Kelley, George L., 25th Hunting Park Ave., Philadelphia, Pa., Chemist and Metallurgist, Edward G. Budd Mfg. Co.

Kimes, Arthur W., 426 Fourth Ave., Pittsburgh, Pa., Managing Editor, "National Glass Budget."

McCann, Donald M., 437 Forest Ave., Zanesville, Ohio.

Nichols, Arthur S., 1800 Farmers Bank Bldg., Pittsburgh, Pa., Chemist, Harbison-Walker Refractories Co.

Poschadel, Leonard R., 155 Garfield Ave., Milwaukee, Wis., Mgr., Propriety China Dish Mfg. Co.

Rodgers, Joseph P., 2414 Connecticut Ave., Baltimore, Md., Manager, Feldspar Dept., Products Sales Co.

Sheerer, Mary G., Newcomb School of Art, Newcomb College, New Orleans, La., Professor of Ceramic Decoration.

Shoemaker, Charles S., Arnold, Pa., Chemist, American Window Glass Co.

Snyder, George R., 3440 Louisa St., Oakland Sta., Pittsburgh, Pa., Metallurgist, Harbison-Walker Refractories Co.

Stief, W. C., The Florentine Pottery Co., Cambridge, Ohio.

Thompson, J. E., 2507 Townsend Ave., Detroit, Mich., Enameling Dept., Detroit Stove Works.

Vail, James G., 121 South 3rd St., Philadelphia, Pa., Chemical Director, Philadelphia Quartz Co.

Weaver, Robert A., 818 Finance Bldg., Cleveland, Ohio, President, The Ferro Enamel Supply Co.

Weber, Harry W., 2763 Bergman St., Corliss Sta., Pittsburgh, Pa., Assistant Supt., Vitro Manufacturing Co.

CORPORATION

Atlantic Terra Cotta Co., 350 Madison Ave., New York City (*William H. Powell, Pres.*).

Conkling-Armstrong Terra Cotta Co., 410 Denckla Bldg., Philadelphia, Pa. (*Thomas F. Armstrong, Pres.*)

Enterprise White Clay Co., Ltd., Real Estate Trust Bldg., Philadelphia, Pa. (*H. S. Donaldson, Treas.*)

Federal Terra Cotta Co., 101 Park Ave., New York City. (*De Forest Grant, Pres.*)

Gladding McBean & Co., Crocker Bldg., San Francisco, Cal. (*Atholl McBean, Sec.*)

Heidenkamp Plate Glass Co., Springdale, Pa. (*Jos. Heidenkamp, Pres.*)

O. W. Ketcham, 125 North 18th St., Philadelphia, Pa. (*O. W. Ketcham.*)

John Maddock & Sons, Trenton, N. J. (*H. E. Maddock, Vice-Pres.*)

New York Architectural Terra Cotta Co., 401 Vernon Ave., Long Island City, N. Y. (*R. F. Dalton, Pres.*)

South Amboy Terra Cotta Co., 105 Nassau Street, New York City. (*Peter C. Olsen.*)

The Wehrle Co., Newark, Ohio. (*W. W. Wehrle.*)

Sections and Divisions

ST. LOUIS SECTION

The first social affair ever held by this Section occurred at Forest Park Highlands, on Thursday, June 29, 1922. A number of ladies were present and the occasion was a decided success.

The Section met at the Highlands at six o'clock. A number of the members took a swim in the pool, after which everyone enjoyed a chicken dinner served on the porch of the Cottage.

After dinner the Section was entertained by Dr. O'Connell, of the American Museum of Natural History. Dr. O'Connell, of the Geology Department, is taking a hike around the world. She is traveling alone and had some interesting experiences to tell us.

Following Dr. O' Connell's talk the party was taken in charge by Mr. George Thomas

of the Highlands Fire Clay Company, who proceeded to show us the mysteries and wonders of the "Hall of Laughter" and various other attractions.

Judging from the noise made by the party as they rode the Slide, the Whirling Tub, the Shaking Stairway, or sat in a chair to rest, only to leap suddenly into the air, the Hall of Laughter is well named.

After an hour of hilarity the party proceeded to the Dance Hall, where the remainder of the evening was spent among the clang of the Cow Bells and the wail of the Saxophone.

W. R. Morgan, of the Evens & Howard Fire Brick Co., has been elected secretary of the Section, in place of the present incumbent who is moving from the vicinity.

A. B. CHRISTOPHER, *Secretary.*

PITTSBURGH DISTRICT SECTION

At the June meeting of the Pittsburgh District Section the following official actions were taken:

It was voted to appoint J. W. Hepplewhite secretary of the section to fill the unexpired term of J. W. Wright. Mr. Wright is resigning because of the pressure of other duties which interfere with the proper dispatch of the work of the secretary's office.

It was voted that J. W. Hepplewhite should represent this Section on the nominating committee of the parent society.

J. W. HEPPLEWHITE, *Secretary.*

ENAMEL DIVISION

The Research Sub-Committee of the Enamel Division for the investigation of Cast Iron met at Cleveland, Ohio, May 12, 1922, and laid out a comprehensive program for an investigation of cast iron for enameling purposes, with special reference to the relation of the iron to blistering of the enamels.

The following outline gives the principal points to be considered in the investigation:

I. Raw Materials to Finished Casting:
  A. Source and Analysis of Raw Materials.
    1. Pig Iron
    2. Scrap
    3. Coke, etc.
  B. Molding Practice.
  C. Melting Practice.
  D. Analysis of Cast Iron.
    1. Chemical Composition
    2. Metallographic Examination
    3. Physical Tests.

II. General Treatment of Castings:
  A. Annealing
  B. Sand Blasting
  C. Pickling
  D. Welding
  E. Grinding
  F. Machining.

III. Treatment of Enamels:
  A. Application of Enamel
  B. Burning of Enamel

As a means of starting the work, it was suggested that the various points in the outline, on which there is already valuable information among the members of the Enamel

Division, be taken up with the Bureau of Standards by way of turning in all available information which members have bearing on the subject.

It is planned, as a preliminary part of the work, to have the interested members of the Division furnish samples of castings which develop blistering as well as specimens of suitable iron. These samples will be examined by the Bureau of Standards for chemical composition, metallographic structure, enameling properties when coated with several types of enamels, and such other properties as may seem desirable. In addition, it is desired to obtain a history of the castings, including all available information on the cupola charge, nature of the pig iron, etc., treatment of the casting previous to and in the enameling operations, and behavior in the enameling operations. This information will be furnished through a questionnaire to be submitted by the Committee.

In this manner, it is believed that valuable information will be obtained as to the type of iron best adapted to cast iron enameling, which will permit of further systematic studies. The Bureau has arranged to install an experimental cupola to do this work after the preliminary results have been compiled.

The Committee desires the coöperation of those interested in the enameling of cast iron.

R. R. DANIELSON, *Chairman*
B. B. KAHN
W. C. LINDEMANN
M. E. MANSON
H. R. MILLS
E. P. POSTE
Research Committee on Cast Iron.

NOTES AND NEWS

WHITEWARE STUDIES IN PACIFIC NORTHWEST

The United States Bureau of Mines, in coöperation with the University of Washington, will undertake an investigation of the residual kaolins and feldspars of eastern Washington and northwestern Idaho for whiteware bodies. The work to be done will follow the lines of the kaolin investigations now under way at the ceramic experiment station at Columbus, Ohio. The work will be done in the new mines laboratory of the University of Washington at Seattle.

GEORGIA CLAYS AND BAUXITES

In the course of the investigation of Georgia clays and bauxites, being conducted by the Bureau of Mines at the ceramic experiment station, Columbus, Ohio, bricks were recently made from twelve of these clays, previously calcined at 1450° C. Porosities, load tests under heat, spalling tests and slag penetration tests were run on the burned bricks, some of them proving to be of excellent quality. The more bauxite clays did not make sufficiently dense bricks to withstand the load and spalling tests.

BRICKS FROM DOLOMITE

At the ceramic experiment station, Columbus, Ohio, the Bureau of Mines has made standard sized bricks from calcined dolomite and from raw dolomite using 10 per cent of the flux Fe_2O_3, Al_2O_3, SiO_2. Calcined dolomite was found undesirable for making into bricks as the mud slakes so rapidly, and on account of enormous shrinkage during drying and burning, all samples cracked badly. Raw dolomite, together with 10 per cent flux, gives excellent promise. The bricks so burned to 1450° C were sound, of high density and have not yet shown signs of slaking when subjected to the boiling test.

Fluorspar Investigation

R. B. Ladoo, mineral technologist of the U. S. Bureau of Mines, recently spent a month in the southern Illinois and western Kentucky fluorspar field in order to complete the investigation of the fluorspar industry. The outstanding feature of the fluorspar situation is that our known reserves are very low, and unless new deposits are found, fluorspar will be very scarce and expensive within a few years. The development of possible substitutes is being considered. The object of the fluorspar investigation is the eventual preparation of a bulletin on all phases of the fluorspar situtiaon.

Meeting of the American Chemical Society

Pittsburgh will be the host of the American Chemical Society at its Annual Fall meeting, from September 4th to September 9th, inclusive. All of the divisional meetings will be held at the Carnegie Institute of Technology, while the general meetings are scheduled at Carnegie Music Hall.

An exceptional program has been outlined for the entire week, with a variety of social events for the Councilors and their wives.

By special arrangements, the Committee of the Pittsburgh Section of the A. C. S. has obtained dormitory privileges for the Councilors at Carnegie Tech. during the meeting. The men's dormitories will be opened to house 350. One of the women's dormitories has been offered for the use of Councilors' wives.

American Construction Council Organization Meeting

The American Construction Council was formally launched as a result of a two-day organization meeting held in Washington June 19 and 20. The meeting was attended by about 170 representatives of the various groups concerned with construction. Mr. Hoover opened the meeting with a characteristically pointed and illuminating address. This was followed by an instructive address by Mr. Booth of the Guaranty Trust Company of New York. One of the inspiring addresses was delivered by Mr. E. J. Mehren. Messrs. Townley and McClellan delivered brief addresses and otherwise participated in the conference. Mr. Townley stated that the Executive Board of the Federated American Engineering Societies had voted an expression of cordiality and coöperation. The key-note thought of each address was the great need for the formation of some agency that would have as its chief function the removal from the construction industry the many ills that it now possesses. The newly elected Executive Board is to meet with Mr. Roosevelt for the purpose of electing the officers of the Council. The program committee submitted the following as the lines of activity to be undertaken by the Council. These recommendations were adopted by the conference: (1) The formation of a code of ethics acceptable to the whole industry and to the public; (2) Gathering of adequate statistics from all sources; (3) Reduction of the national shortage of building trade mechanics and the establishment of the necessary apprenticeship system; (4) Coöperation in establishing uniform building codes throughout the country; (5) Coöperation with railways in expediting the revision of existing freight rates on construction materials; (6) The establishing and strengthening of local organizations throughout the country to bring about the coöperation of all elements in conformity with the principles of the Council; (7) The investigation of the evils of seasonal employment and migration of labor; (8) The encouragement of local building shows; (9) Simplification and the elimination of waste; (10) Education of the public as to the desirability of a better distribution of its construction and maintenance requirements; (11) Promotion of health and safety for workmen and the reduction of loss of life; (12) The reduction of waste of construction materials from preventable fires; (13) The study of old buildings in order to establish superior methods of construction; (14) The education of the public as to the necessity and economy of properly maintaining structures.

Research School in Australia

Those who are interested in the spread of research in ceramics throughout the world will be glad to note that a research center has been established by the Australian Commonwealth at the Brunswick Technical School. Experiments will be conducted and tests made at the Brunswick School of Pottery, and it is expected that this will encourage and hasten the development of the clay-working industry in Australia.

Who's Where in the American Ceramic Society

E. E. Ayars, of the American Refractories Co., has been changed from Danville, Ill., to Devil's Lake, Wis.

Lawrence H. Brown, formerly with the R. Thomas & Sons Co., East Liverpool, is now connected with the Edwin M. Knowles China Co., Newell, W. Va.

F. M. Burt, of the American Stamping and Enameling Co., has moved from Massillon, Ohio, to Westmoreland, W. Va.

A. B. Christopher, formerly of the Evens & Howard Fire Brick Co., and secretary of the St. Louis Local Section, has associated himself with the Southern Brick Co., Jonesboro, Ark.

Dwight T. Farnham has severed his connection with the C. E. Knoeppel Co., of which he has been vice-president, and has opened private offices as a Consulting Engineer at 347 Madison Avenue, New York City.

E. H. Fritz, of the Pittsburgh High Voltage Insulator Co., is now located at 609 Main St., Latrobe, Pa.

G. W. Rathjens has notified the office that he is no longer in St. Paul, Minn., but at 6106 Dorchester Ave., Chicago, Ill.

Charles F. Ryan, who has been with the Chapman-Stein Furnace Co., at Mt. Vernon, Ohio, is now with the Russell Engineering Co., St. Louis, Mo.

Fred H. Schwetye has resigned his position with the Laclede-Christy Clay Products Co. and has accepted the position of Secretary of the Grand View Fire Clay Co., St. Louis, Mo. Mr. Schwetye was in the employ of the former company for sixteen years and during the last four years was General Superintendent of the plants. In his new position he will be in charge of mines and plants of the Grand View Co., manufacturing special prepared clay mixtures for the glasshouse, zinc, and foundry trade, as well as high grade refractory materials.

B. B. Swinnerton has recently become connected with the Limoges China Co., at Sebring, Ohio.

E. W. Washburn, formerly director of the department of Ceramics at the University of Illinois, is at present in Europe. His permanent address is the National Research Council, Washington, D. C.

Calender of Conventions

AMERICAN CERAMIC SOCIETY, Summer Excursion Meeting—Montreal and Canadian points, August 13–19, 1922.

American Society of Sanitary Engineers—Cedar Point, Ohio, August 22–24, 1922.

Annual Safety Congress of the National Safety Council—Detroit, Mich., August 28–September 1, 1922.

American Chemical Society—Pittsburgh, Pa., September 5–9, 1922.

National Association of Brass Manufacturers—Detroit, Mich., September 6–8, 1922.

Association of Iron and Steel Electrical Engineers—Cleveland, Ohio, September 11–15, 1922.

Eighth National Exposition of Chemical Industries—New York City, September 11–16, 1922.

American Electrochemical Society—Montreal, Canada, September 21–23, 1922.

American Institute of Mining and Metallurgical Engineers—San Francisco, Cal., September 25–28, 1922.

National Association of Commercial Organization Secretaries—Chicago, Ill., October 23–25, 1922.

National Society for Vocational Education—Detroit, Mich., November 30–December 2, 1922.

Dental Manufacturers Club—St. Louis, Mo., November 20, 1922.

Dental Exhibit of the Dental Manufacturers Club—St. Louis, Mo., November 21–24, 1922.

National Exposition of Power and Mechanical Engineering—New York City, December 7–13, 1922.

Mining and Metallurgical Society of America—New York City, December 7–13, 1922.

American Malleable Castings Association—Cleveland, Ohio, January 10, 1923.

National Jewelers Board of Trade—New York City, January 18, 1923.

Canadian National Clay Products Association and Western Ontario Clay Workers Association—Hamilton, Ont., January 24–26, 1923.

American Concrete Institute—Detroit, Mich., February, 1923.

National Association Builders Board of Control—Des Moines, Iowa, February, 1923.

AMERICAN CERAMIC SOCIETY—Pittsburgh, Pa., February 12–17, 1923.

Natural Gas Association of America—Louisville, Ky., Spring 1923.

American Institute of Mining and Metallurgical Engineers—New York City, February 19–22, 1923.

National Association of Stove Manufacturers—Richmond, Va., May 9–10, 1923.

American Association of Museums—Charleston, S. C., May, 1923.

JOURNAL AMERICAN CERAMIC SOCIETY

Preparation of Abstracts

Every article in THIS JOURNAL is to be preceded by an abstract prepared by the author and submitted by him with the manuscript. The abstract is intended to serve as an aid to the reader by furnishing an index and brief summary or preliminary survey of the contents of the article; it should be suitable for reprinting in an abstract journal so as to make a reabstracting of the article unnecessary. The abstract should, therefore, **summarize all new information completely and precisely.** Furthermore, in order to enable a reader to tell at a glance what the article is about and to enable an efficient index of its subject matter to be readily prepared, the abstract should contain **a set of subtitles** which together form a **complete and precise** index of the information contained in the article. This requires at least one and often several subtitles even for a short abstract.

In the preparation of abstracts, authors should be guided by the following rules, which are illustrated by the abstracts in THIS JOURNAL for February and March, 1921.* The **new information** contained in an article should first be determined by a careful analysis; then the subtitles should be formulated; and finally the text should be written and checked.

Rules

1. **Material not new** need not be analyzed or described in detail; a valuable summary of a previous work, however, should be noted with a statement indicating its nature and scope.

2. **The subtitles should together include all the new information**; that is every measurement, observation, method, improvement, suggestion and theory which is presented by the author as new and of value in itself.

3. **Each subtitle should describe the corresponding information so precisely** that the chance of any investigator being misled into thinking the article contains the particular information he desires when it does not, or vice-versa, may be small Such a title as "A note on blue glass," for example, is evidently too indefinite a description of information regarding "Absorption spectra of glass containing various amounts of copper-cobalt and chromium-cobalt." General subtitles, such as "Purpose" and "Results" should not be employed as they do not help to describe the specific information given in the article.

4. **The text should summarize the authors' conclusions and should transcribe numerical results of general interest,** including those that might be looked for in a table of physical and chemical constants, with an indication of the accuracy of each. It should give all the information that anyone, not a specialist in the particular field involved, might care to have in his note book.

5. **The text should be divided into as many paragraphs** as there are distinct subjects concerning which information is given, but no more than necessary. All parts of subtitles may be scattered through the text but the subject of each paragraph, however short, must be indicated at the beginning.

6. **Complete sentences** should be used except in the case of subtitles. The abstract should be made as readable as the necessary brevity will permit.

7. The ms. of all abstracts must be typewritten and double or triple spaced.

* The rules were prepared by the Research Information Service of the National Research Council. The Society is indebted to Dr. G. S. Fulcher of the Corning Glass Works (formerly with the National Research Council) for the rules and the illustrative abstracts.

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BULLETIN
of the
American Ceramic Society

A Monthly Publication Devoted to Proceedings
of the Society, Discussions of Plant Problems, Discussions
of Technical and Scientific Questions and
Promotion of Coöperative Research

Edited by the Secretary of the Society Assisted by Officers of the Industrial Divisions

F. H. Rhead, M. C. Farren } Art
B. T. Sweely, R. R. Danielson } Enamel
J. C. Hostetter, A. E. Williams } Glass
J. S. McDowell, F. A. Harvey } Refractories
F. K. Pence, C. C. Treischel } White Wares
A. F. Hottinger, R. L. Clare } Terra Cotta
C. F. Tefft, M. B. Greenough } Heavy Clay Products

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Vol. 1 September, 1922 No. 5

EDITORIALS

THE VALUE OF THE ABSTRACT SERVICE
Rendered by
The American Ceramic Society

The American Chemical Society has ten times (about 17,000) as many members as has this Society and the very large majority of these members pay $15.00 a year membership subscription, more because of the service rendered by that Society in abstracting the worlds' literature on general and applied physics and chemistry than because of any other service. In order to render this service of abstracting their Society must maintain a virile, progressive organization, promoting and discovering facilities for research. To retain this position of authority it is absolutely essential to hold conventions, to maintain Industrial Divisions, to establish and to invigorate local sections, to be engaged in the compilation of monographs, etc., and in many other ways to promote and facilitate research. Whereas publishing abstracts of the worlds' current literature is but one of the many activities made possible by the organized coöperation of so many, it is the one service that is considered by most of the members as being worth more than their membership subscription.

The American Ceramic Society is engaged in this same sort of work but limiting its activities to the promotion of ceramic research. There is in this Society as in the Chemical Society that same need of well-organized

activities to make possible the publication of original literature and the abstracting of ceramic literature. This Society is obligated to its larger sister organization for an exchange of facilities for abstracting, an exchange which has been far from balanced, the Chemical Society rendering the much larger service. It nevertheless is true that as the American Ceramic Society has grown in strength and has increased its activities, the abstractors have increased their output until now the exchange between the two Societies is about 50–50.

Now as to the value of this service. We have repeatedly said that it was worth more to corporations than the total fees paid by them as corporations and for personal memberships of their employees. Here is concrete evidence: One person mailed 900 cards to this office each card showing an abstract of a published article. The package was insured for $2000. In a letter the member said that $2000 would not measure the loss he would sustain if they should not be returned.

Many corporations employ abstractors and go to the expense of printing and distributing among their employees those abstracts that are of direct value in their work.

These citations show that the monetary value of abstracts exceeds many times the membership fees paid to a Society that is sufficiently well organized and activated as to produce and publish each month an average of 135 to 150 abstracts. This is but a single part of what the members of this Society are receiving for the small membership fee of $7.50 for personal and $25.00 for corporations.

THE "WHAT FOR" OF THE AMERICAN CERAMIC SOCIETY

Does It Conflict with Trade Associations

A little while ago a prominent manufacturer asked if the Trade Association, of which he is an officer, was not engaged in the same work as the American Ceramic Society.

The first answer was Yes, in part.

One of the Industrial Divisions is working on the same problems as is his particular Trade Association with this difference—the Industrial Divisions of the American Ceramic Society bring together on one program of activities representatives of all the research agencies, collegiate, federal, state and industrial, with the trade associations and users of ceramic products.

The second answer was No.

In the first place, each Industrial Division of the Society is coöperating and coördinating with all industrial ceramic groups, each Division well organized and each working not only on its own distinctive and special problems but also on the many problems that are of common interest.

In the second place, the Society publishes monthly the results of investigations made in the several laboratories, and also discussions on plant problems, an undertaking which is quite foreign to the scope of trade associations.

In the third place, the Society publishes each month an abstract review of the worlds' literature of interest to ceramists. This service to the technical men employed in plants and by trade associations is alone worth all the financial support required to maintain the activities of this Society.

Then, in the fourth place, the Society is especially organized and equipped for the task of coördinating ceramic research activities of all ceramic groups in the technology and science of ceramics and for the publishing of the findings made in each of the researches. The trade associations are organized and equipped especially to secure and maintain coöperation of a group of manufacturers of the same sort of product on such problems as trade, traffic, tariff and accounting—the business problems. The technical organization would make a poor shift with the business problems, and, without the coöperation of a scientific organization the trade associations would make a poor shift with research in the technical and scientific problems. It is necessary that trade associations employ the personnel and facilities of a technical and scientific research organization, such as are found in the federal bureaus and in collegiate institutions.

It is absolutely sound economically that trade associations be engaged in technical and scientific researches in coöperation with the federal bureaus and the colleges. It is absolutely essential too, that each trade association maintain a "Technical Research Committee." The economies of such organized technical research activities are principally twofold: (1) the industrial executives learn the need and value of technical research, thus assuring plant application of the findings, and (2) each trade group confines its researches to problems of immediate manufacturing concern to that group.

Where does the American Ceramic Society come in as an essential in this program of research other than as a central publishing agency, owned and controlled jointly by all the ceramic groups?

Here is the answer: There are many agencies now working in ceramic science and art; but except for their contacts through the American Ceramic Society, these several agencies are without any attempt at coordinating their activities, or the results of their undertakings. Without the American Ceramic Society in which the research organizations and the manufacturing groups have a common interest and responsibility, there would be wastage and duplication of efforts and their would be no gleaning and publishing of the worlds' knowledge in ceramic science and technology. This is often spoken of collectively as the educational enterprise of the Society.

It is fairly certain that there are many problems deserving attention which are not receiving the attention of the research committees of the trade associations. There are fundamental problems of which universities could most effectively be engaged but to which their attention would not be drawn except through close contact with the industrial representatives in the Society. No trade association or research organization can undertake at one time more than a limited number and scope of research activities whereas each manufacturer has many urgent problems on which coöperation with other manufacturers or other agencies is valuable if not vital.

It is certain that there is value in coördination in technical research by the several ceramic groups, which groups, though diversified, have many problems in common. There are many manufacturing problems deserving attention which are not being studied in systematic coöperation. It is the function of the committees of the American Ceramic Society not only to bring these to the attention of competent research agencies but to follow through the solving of them, bringing to their solution the very best minds and knowledge.

The largest and most important functions of the American Ceramic Society are (1) to establish and maintain the mechanisms by which the several research agencies and the several industrial groups may have coördination and coöperation, not two by two, but all together, the ceramic crafts and ceramic laboratories jointly; and (2) to establish (in the words of Dr. Angell) "assurance of both continuity and community of programs, prompt interchange of findings, especially for purposes of educational training, expert assistance, and, in general, the services of a central body, intelligently in touch with a great variety of undertakings, all of which converge upon the fundamental problems" of all ceramic industries.

This Society does not duplicate the work of trade associations in technical research, for the part taken by the Society in such enterprises differs radically from that of the trade associations. Time has gone when a single manufacturing concern can afford to carry on research in isolation; contact must be had with other concerns through persons or organizations. By the same tokens we recognize that trade associations, universities and federal bureaus can not successfully work in isolation on technical and scientific problems in ceramic manufacturing. There is a need (becoming more and more felt) for a central clearing organization.

The field for and scope of the activities of the American Ceramic Society is clearly defined. It will not engage on problems other than technical and scientific. It will not finance nor be directly interested in the financing of research work. It is an institution organized especially to assist all ceramic research agencies, at no time nor under any circumstances assuming a dictatorial prerogative but ready to direct when called upon, serving most essentially as a general coördinating agency for all of the specialized ceramic

research agencies and industrial groups, and an educational institution alike for the technologist, the scientist and the plant operator.

The Society does not duplicate nor conflict with trade associations in technical research activities; the interests of each are supplementary.

CHEMICAL EXPOSITION SPEAKERS

Exposition of Chemical Industries, Grand Central Palace, New York

That portion of the program for the Eighth National Exposition of Chemical Industries which will be held during the week of September 11–16th at the Grand Central Palace, New York, that has been definitely arranged, contains the names of a number of well-known speakers. Herbert Hoover, Secretary of Commerce, and frequently referred to as "the business man of the Cabinet," will speak on the subject:—"Standardization and What It Can Do for the Chemical Industry."

Other addresses thus far scheduled on the partially arranged program of the 1922 Chemical Exposition, include a number of particular interest to the ceramic industry of the United States. The Standardization Program, to which one whole afternoon session of the program will be given, will include the following speakers: W. D. Collins of the United States Geological Survey on "Moderation in Standardization;" N. F. Harriman of the United States Bureau of Standards on "Standardized Testing Apparatus;" I. G. Jennings, general representative of the Glass Container Association on "A Discussion of the Reasons for the Varieties of Shapes and Sizes;" J. M. Roberts, Secretary of the Apparatus Manufacturers Association of the United States, on "What Has Been Accomplished in the Standardization of Scientific Apparatus;" Ross C. Purdy, Secretary of the American Ceramic Society, and Chairman of the Committee C–8 on Refractories of the American Society for Testing Materials, on "Standardization of Fire Clays and Refractories;" Emerson P. Poste of Elyria Enameled Products Co., on "Standardization of Enameled Ware for Chemical Industries."

Speakers for other groups of chemical and allied associations will take part in these programs.

Other afternoon technical and business sessions will be under the direction of the American Ceramic Society, the Association of Synthetic Organic Chemical Manufacturers of the United States, the Technical Photographic and Microscopical Society, and the Salesman's Association of the American Chemical Industry, the time for which meetings has not as yet been set. All sessions will be held in the special Grand Central Palace Auditorium. The motion picture program which will be held in the evenings exclusively, now has on it the following: "The Story of Asbestos," four reels, by courtesy of the United States Bureau of Mines and the

Johns-Manville Co.; "Preparation of Nickel and Securing Copper as a By-product," four reels, by courtesy of the International Nickel Co. accompanied by discussion; "The Romance of Cotton," one reel, accompanied by discussion by Dr. David Wesson; "Prospecting for Gold in Northern Ontario," two reels; "Assaying for Gold in Northern Ontario," one reel; both courtesy of the Ontario Department of Mines. Numerous other details of the Exposition program have been arranged tentatively and as soon as definite confirmation can be obtained, they will be announced.

THE ITALIAN MAJOLICA PROCESS AND PAINTING OVER TIN ENAMELS[1]

By Frederick H. Rhead

ABSTRACT

Reference is made to historical types. Practical conditions are discussed, types of glazes are given, and methods of application are outlined. There are also comments in connection with one-fire products.

The processes involved are discussions A-3 and A-4: "The Italian Majolica Process," "Painting over Tin Enamels," are so closely related that they are taken together.

General Outline of the Processes.—Conditions at hand, and the particular style of decoration then prevalent, determine the type of pottery made by any particular country. The Chinese happened to find unlimited supplies of kaolin, and so produced porcelains. The Italians and Persians used the available red and buff faience clays, and in order to obtain white and light colored grounds, developed opaque tin enamels and applied their decorations over these.

Sometimes the ware was glazed all over with opaque white enamel and the decoration applied over this; or a color palette, with the white enamel as a base, was prepared, and the colored glazes were painted over a modeled surface. The Della Robbia wares were executed in this manner.

Painting over Tin Enamels.—This process is much like that of underglaze painting on the bisque except that instead of painting over a biscuit surface with calcined metallic stains, the decorator uses similar stains but applies these over an unfired glaze ground. Where more brilliancy is required, a thin coat of transparent glossy or mirror glaze is sprayed over the decoration which is consequently sandwiched between an enamel and a shiny glaze. But more often, especially in the case of the Italian wares, the usual method is to simply paint over the unfired enamel and then to fire the ware to a temperature that will fuse the colors into the enamel which develops a semi-mat or smooth texture.

The Italian and Persian wares were mostly one-fire products, although it is possible that occasionally the clay ware was given a soft bisque fire to strengthen it for the glazing and decorating processes.

The Order of the Processes:

1. The ware is made of a red or buff terra cotta body and dried.
2. The ware is dipped or brushed with a level and smooth coat of the opaque tin enamel.
3. The design is drawn or stenciled over the shape and the decoration applied in the manner described in the paper on underglaze painting.[2]

[1] Discussion prepared for the Art Division of the American Ceramic Society, Twenty-fourth Annual Convention, St. Louis, 1922.

[2] F. H. Rhead, *Jour. Amer. Ceram. Soc.*, **5**, 376 (1922).

4. The ware is ready for the firing process unless a thin application of the transparent glaze is desired.

Condition of Ware to be Glazed.—Either clay or biscuit ware may be glazed with the opaque enamel. If the glazing is done in the clay state, the ware must be almost or quite dry. Any clay which will not disintegrate, blister or crack when the glaze is applied may be used. The process of glazing fragile wares is obviously a delicate one, and, where quantity production is concerned, it is a question if the loss incurred in broken clay ware does not set aside any advantages or economies derived by the elimination of the bisque fire. Personally, I like the one-fire process because I get much better surfaces and textures when the body and glaze are developed to maturity together. But this is entirely a matter of local conditions. Most of the early art and faience wares, together with some of the finest porcelains, were entirely one-fire productions, and at the present time much of the European faience and art wares (I do not refer to table and utilitarian wares) are made in one fire.

There are a number of concerns in this country also making one-fire products. I have had five years practical experience in California making ornamental wares and tile. The production averaged about one thousand pieces per week, and over ninety per cent of this was finished in one fire although the ware was very carefully made and often highly finished and expensively decorated.

Enamels, mates, underglaze decorations, lustres, and mirror glazes were used in the production of these wares. In fact, about the only practical reason a bisque firing is adopted is because it has been found practical and economical for the large production of the more fragile wares, and because it makes possible the storage of unglazed stock without incurring large losses in broken wares.

While the tin enamel and majolica processes may be done in either one or two fires, it is advisable for the beginner or average studio potter to use two fires to eliminate the danger of breakage, which always accompanies inexperienced handling.

Methods of Glazing for Painting over Tin Enamels.—Any of the known methods are practical—dipping, spraying or brushing.

For commercial work, dipping is most convenient, although certain ornamental pieces require skillful treatment to obtain a thoroughly even coat of glaze over an upright or complicated surface. For elaborate decorative work, a brushed surface using a glaze containing a strong solution of gum tragacanth may be advisable. A number of painters doing individual work prefer to glaze their own pieces.

A coating of glaze averaging about one-sixteenth of an inch in thickness is required. As a rule, a glaze containing about ten per cent or more of tin oxide need not be so heavily applied. Glazes containing less tin

oxide, and those fired to higher temperatures than cone three or four, will require heavier applications. For tile and other flat surfaces, the glaze may be applied to a thickness of almost an eighth of an inch.

The tin enamels[1] are comparatively non-flowing glazes unless there is an extreme condition of overfiring; consequently the applied surface must be level and smooth.

Methods of Decoration.—For average work, the methods suggested[2] for underglaze painting on the biscuit will apply in this process. Any of the mediums except turpentine and fat oil may be used.

In the Italian processes, the design was usually sketched lightly over the glaze and afterwards outlined with cobalt blue, manganese, or an iron brown. Almost any of the colors used in the biscuit process are practical, although it may be advisable to eliminate greens containing chrome which usually flashes or fumes the tin glaze.

Either flat or painted treatments are possible. One has only to refer to examples of Italian wares in the various museums, and also to the skillfully painted Delft wares.

Some of the Italian works of the fifteenth and sixteenth centuries were enriched with lusters applied after the glazed firing.

There have been some examples of painting over tin enamels where the glazed ware was fired before the decoration was applied. A number of European potters have produced in this manner but this ware lacks the depth and brilliancy of decorations over the unfired glaze.

Besides the underglaze colors, or calcined stains, non-flowing colored glazes of various textures can be applied to the tin enamel ground, either alone or in combination with the underglaze colors. The Persians were very skillful in their manipulation of glazes over a glaze, or slip engobe over which would be applied a light coat of transparent glaze.

The Majolica Process.—*One can obtain a fair idea of this process by* contrasting it with the other processes under discussion. In painting over tin enamels the stains are applied over an unfired glaze. In underglaze painting on the biscuit, the stains are painted on the biscuit body and the ware afterwards glazed. In the inlay process, the glazes are applied on the clay or bisque within a raised, flat or sunken outline. In the majolica process, the colored palette consists of colored glazes, as in the inlay process, and these are applied over the modeled surface. No outline or boundary is used.

Assuming that the decoration consists of a modeled fruit border, a typical Italian motif, the palette will probably consist of two copper greens, uranium, iron, or antimony yellows, chrome tin pinks, cobalt blues, and manganese and iron browns.

[1] *Jour. Amer. Ceram. Soc.*, **5**, 259 (1922).
[2] *Ibid.*, **5**, 376 (1922).

A gum medium is used and the colors are applied directly to the clay or bisque surface. Certain details may be accentuated by means of stains, or colored glazes lighter or darker in tone, or of greater brilliancy.

In modern commercial practice, the term majolica was applied to any type of colored glaze painting, but in these notes the wares referred to are the Italian wares of the Della Robbia type.

Of course other types of glazes may be applied in the manner described. In this country quite fine faience and terra cotta wares are decorated with colored mats treated in the same manner as were the old tile enamels, and the effects are quite as interesting so far as harmonies and soft effects are concerned. But the average mat is a non-reflecting glaze, and lacks the brilliancy and lustrous quality of the enamel. The mat glaze is obviously a beautiful and valuable decorative medium, but it is only one of the many possibilities open to the ceramic artist and decorator.

American Encaustic Tiling Co.
Zanesville, Ohio

DISCUSSION ON "THE TESTING OF SILICA BRICK"[1]

Mr. Greaves-Walker:—I am sure the expression of this division is that we appreciate the visit of Dr. Endell and his arranging to be here at the time of our Ceramic meeting. Dr. Endell is, without doubt, the leading silica brick expert of Germany and we have in this room probably all of the experts of this country, or those we class as experts—I might mention Messrs. Harvey, McGee, McDowell and Howe—and out of those four we should certainly get some discussion on the recommendations that Dr. Endell has made in regard to silica refractories. The paper is open for discussion.

Dr. Harvey:—I have been exceedingly interested in this paper—it covers the same ground, of course, in which he and I have been working for three or four years. I would very much prefer to study this paper and write a discussion on it than to attempt to discuss it finally at this time. I do not believe it is necessary to specify both gravity and linear expansion. I think if you have specified one you have covered both.

Another thing that struck me is that Dr. Endell takes one hour and a half to heat silica brick from room temperature to about 1600°C. It is our experience that if you heat silica brick as rapidly as that, you would get excessive expansion and develop cracks; linear expansion measured by that method, in our experience, is more the function of the temperature change than the degree of the conversion of the quartz.

The third fact that occurred to me is that the method which Dr. Endell uses for determining the percentages of cristobalite and tridymite seems to

[1] K. Endell, *Jour. Amer. Ceram. Soc.*, **5**, 209 (1922).

give very much higher values than we have in American brick. Therefore, as I state, before I could discuss that I would like to study the paper first.[1]

MR. ROSS:—In Dr. Endell's remarks yesterday he stated that some of the German quartzites are made of a large percentage of rather finely crystallized material which transforms more rapidly when given heat treatment than do our quartzites. That might answer Dr. Harvey's questions as to more tridymite and cristobalite.

MR. GREAVES-WALKER:—Dr. Harvey, I believe, referred to the fact that Dr. Endell got higher values in the examination of American brick than we have been able to get.

MR. MCDOWELL:—Dr. Endell's figures for American brick check rather closely those of Insley and Klein. I am not altogether sure just how closely they do agree. They are higher than the figures which I obtained about five years ago.

MR. GREAVES-WALKER:—I believe Dr. Endell obtained somewhere around 80% cristobalite in the American brick tested by him. Is that not extraordinarily high?

MR. MCDOWELL:—Perhaps Dr. Endell had Mr. Insley's figures in mind?

DR. ENDELL:—I think Insley found 75–80% cristobalite. I suppose Mr. McDowell sent to me only the best kind of American brick. In regard to our heating to 1600°C, I can say that most of our best silica bricks like the American silica bricks stand this heat treatment very well. I know there are several kinds of silica brick that do not stand this heating but the best kind do.

MR. MCDOWELL:—The brick sent Dr. Endell were commercial well-burned brick such as are now being made, and were possibly burned a little higher than was customary a number of years ago; this might have caused some difference in the microscopic analysis.

It should be borne in mind when comparing Dr. Endell's results with my own that my method is not capable of any great degree of quantitative precision. My figures were probably low, that is, the degree of inversion which I showed was probably somewhat less than the actual degree of inversion.

I doubt the practicability of specifying that silica brick shall have a definite content of the three forms of silica. Results are influenced by the method followed in making the determinations, and no method has yet been standardized. Not many petrographers have had sufficient experience in making examination of silica brick for their results to be of very great value.

DR. ENDELL:—I believe that the easiest method to determine the value of silica brick is through specific gravity.

MR. GREAVES-WALKER:—Dr. Endell, I believe the silica brick manu-

[1] *Jour. Amer. Ceram. Soc.*, **5**, 218 (1922).

facturers of this country are aware of the fact that they have to adopt two different standards, one for Baraboo quartzite and one for Medina quartzite. It is possible, under some conditions, to get as low specific gravity on Baraboo quartzite as on Medina quartzite, but perhaps the products made from Baraboo quartzite would be equal to those made from Medina even if there was a difference of 0.04 in the specific gravity. The probabilities are that when figures are adopted we will have two, one for what we call Western silica and one for Eastern silica.

Mr. McDowell:—I believe that 2.33 is a fair average for the specific gravity of brick now being made from Medina rock.

Mr. Greaves-Walker:—Have you not found, Dr. Harvey, that the average brick made of Baraboo quartzite will run 2.33 to 2.34?

Dr. Harvey:—Yes, the figures that Mr. McGee and I arrived at in the paper that has been spoken of showed a difference of 0.016 or, in round number 0.02. Baraboo is higher, I think, by 0.02.

Mr. Ross:—Now that you have spoken of this difference, I would like to have somebody explain why it is.

A Member:—Although I have been far away from this proposition for a few years I recall the original work we did. As far as the structure and the constituents of the Baraboo was concerned, we really saw nothing that was strikingly different from that of the Medina. Our thought all along was that the changes affecting the specific gravity should go closely hand in hand, whatever they were.

Mr. Greaves-Walker:—You probably know that brick made from Medina quartzite is generally burned at a lower temperature than Baraboo quartzite. Some few plants in Pennsylvania burn silica brick to cone 18, but in the West it is not unusual on coke oven work to burn to cone 20 and still get higher specific gravity, showing there is some physical difference. There is certainly some physical difference in type of the rock. It seems harder to bring about the same amount of inversions under the higher temperature conditions with the same length of burn. Have your investigations shown that, Dr. Harvey?

Dr. Harvey:—I am doing all the talking but McGee did all the work. We found that with the Median quartzite, brick which was burned in the commercial burn and reburned for 48 hours at 1450°C, will practically reach the limit of conversion.

With Baraboo quartzite, we found that with 2 or 3 heatings at the same temperature you do not get to the same limit of possible conversion. There is a difference in the rate of conversion. We have an extreme example of that in the quartzites of which Dr. Endell spoke yesterday, where the conversion is even more complete at a much lower temperature and a shorter time. I am not explaining to Mr. Ross why it exists, but we can not get around the fact that it does exist.

Mr. Greaves-Walker:—We have in this country those erratic quartzites of which Dr. Endell spoke. Quartzites from Flint, Indiana, will give you exactly the same results as Dr. Endell got with that one particular German flint. It is the same type of rock from which the Indians made their arrow heads. You can get a very high inversion at a comparatively low temperature, showing there is quite a difference in the rate of inversion in different quartzites.

Mr. Ross:—I think the point has been clearly brought out that there is difference in the rate of inversion, as Dr. Endell stated yesterday, in the different quartzites, some fast and some slow. It seemed to be the fineness of the size of crystals. There are certain grades of quartz throughout the country, such as from certain states in the Rocky Mountains, which have not been successfully used in the manufacture of silica brick. They have developed a punky structure which converts very fast. Is there anybody familiar with that? Is there any connection between the rapidity of transformation and structure, or are there certain impurities in those massive quartz deposits that cause the material to transform very rapidly?

Mr. Greaves-Walker:—Dr. Washburn offered a theory yesterday that was new to me, that of "colloidal quartz" which possibly may help us. When we want to explain why, we will simply tell them, "Why one is colloidal quartz and the other one is not." I am sure, Mr. Ross, I do not know. There has never been any work done on these various quartzites to find out why some of them act as they do, but we have quartz in this country that will give us 80% cristobalite in the regular commercial burn, all the way from cone 15 up to cone 20. There is a difference in their physical appearance but they are all silica—they are all of the same analysis. They appear to make the same kind of a product if they have the right kind of treatment but nobody seems to have found just why we have these differences in the rock or in the product.

By R. M. Howe[1]:—One may conclude from Dr. Endell's paper that he is primarily interested in the strength of silica brick at high temperatures and in their tendency to expand (permanently). The writer agrees with him regarding the importance of these properties but not as to the method of measurement.

Silica brick are extremely difficult to cut without fracturing and are sensitive to rapid changes in temperature, especially below 800 °C. Consequently the American practice of heating full sized brick to 1500 °C in $6^1/_2$ hours appears to possess more merit than this method of heating a small specimen to a higher temperature in 2 hours. The principle of carrying

[1] Received August 9, 1922.

the test to the point of failure is worthy of consideration however, for this is successfully applied in the testing of magnesia and chrome brick under pressure. While the weaker brick are eliminated under pressure of 25 lbs. per sq. in. per $1^1/_2$ hrs. at 1500 °C, no comparison between the stronger is obtained with the standard A. S. T. M. test for silica brick. Both methods might be improved by heating full sized brick at a slow rate to the point of failure, thereby gaining the stronger points of the two practices.

Dr. Endell determines the burn of a silica brick by three different methods—measurement of the permanent expansion at high temperatures, specific gravity and micro-analysis. While all three methods are useful it is quite likely that the specific gravity test is sufficient in most cases. It is simple, accurate, and rapid whereas the micro-analysis is difficult and the expansion test of low precision. This low precision is due to the smallness of the sample (50 mm.,) involved and the tendency to crack under rapid heating (1600 °C in 90 minutes). We have found it to be impossible to secure satisfactory expansion tests on silica brick where they are heated to 1400–1500 °C in 6 hours because of their tendency to fracture under rapid heating. This criticism is removed however, when the test specimens are heated more slowly as at the Semet-Solway Co. laboratory.

During the discussion, values of 2.33 and 2.34 were mentioned as representative for the specific gravity of well burned silica brick. While picked samples may have these or even lower values the run of kiln will be denser.

DISCUSSION ON "THE INFLUENCE OF GRIND AND BURN ON THE CHARACTERISTICS OF SILICA BRICK"[1]

F. A. HARVEY:—There is one point, that of methods for determining the effect of fineness of grind on the modulus of rupture, which is very important. In the open hearth, the problem of spalling seems to be one of importance. Coarsely ground brick work better in open hearth furnace than do finely ground brick.

R. M. HOWE:—When this particular study was started there was considerable talk about basing a specification for silica brick upon the modulus of rupture. Consequently we were very anxious to learn to what extent this property was controlled by the present method of grinding and burning. It developed that the time of grinding was of very little influence although the temperature of burning was extremely important. The fact that spalling is a very important problem was not overlooked but was simply omitted in this particular study.

[1] This is a discussion of the paper by R. M. Howe and W. R. Kerr, *Jour. Amer. Ceram. Soc.*, **5**, 164 (1922). Discussion before the Refractories Division, 1922 Convention, St. Louis.

MR. J. S. McDOWELL:—In connection with silica brick in open hearths it seems there are other characteristics than spalling which affect their life. For example, in the basic open hearth we find that the life of the roof-brick will vary from 200 to 300 heats—probably an average of 250. In acid open hearths, brick of the same brand will last from 1000 to 1500 heats. This strongly suggests that the action of some furnace products has an effect upon subsequent spalling after the brick has been in use for some time.

MR. GREAVES-WALKER:—In line with what Mr. McDowell just stated in regard to the characteristics of silica refractories in roof work, I wish to relate conversation had with the president of a steel foundry company a few days ago. He is operating six ton electric furnaces. They were running basic up to a year ago and were getting the average number of heats from their roofs; then they changed to acid. He told me that under acid conditions he was having absolutely no trouble at all. I think this shows undoubtedly that the volatilized lime from the slag in the basic practice has a great deal to do with the destruction of silica roofs.

MR. McDOWELL:—I really doubt that the study of the spalling characteristics of silica bricks will give a great deal of indication of the service of the roof for the reason that after a brick has been in service a short while it is not the same brick. A number of studies have been made which show the changes which take place in the composition of roof brick while in service. I believe Dr. Endell has collected some data on the subject and a very good paper has been published by Rengade in France. It appears that considerable lime and ferric and ferrous oxide are absorbed, so that silica brick, exposed to furnace gases, instead of having a silica content of approximately 96 per cent, after having been in use for a while, may have a silica content under 90 per cent on the end exposed to the heat. Naturally the spalling characteristics of such a brick would be altogether different from those of an unused brick.

MR. W. A. HULL:—This may not be new, but in connection with what Mr. Howe was saying about hard burned brick not standing up against spalling as well as light burned, I might add that when Professor Fearnside of Sheffield University, England, was at the Bureau of Standards recently, I asked him what they did in England in the way of making repairs upon open hearth furnaces. He stated that they used very light-burned brick, they having given the best results and the least spalling.

DR. HARVEY:—I want to add one thing to what Mr. Howe said about this test on spalling. I do not think the results could be held as establishing the fact that you have the least spalling in service with an under-burned brick. We were trying to determine a method of testing resistance to spalling. The Carnegie Steel Company have a method which they recommend for testing spalling of silica brick in a furnace temperature of

540°C. They heat the brick for an hour and then plunge into cold water. Now the most rapid expansion in silica brick occurs between the temperature of cold water and 540°C. In this spalling test the brick are heated back and forth through this expansion range, which is something that does not happen in actual practice.

In actual practice, I do not believe we have anything which shows that under-burned silica brick, or light burned silica brick, stand better than the hard-burned brick. This test shows, and the results show, as far as the test is concerned, that under-burned brick will stand the test better than hard-burned brick, but I do not believe it necessarily follows that that would be true in actual practice.

Mr. Howe:—These results justify the practice of using different grinds for the nine inch and shape mud, for the strength of the finished products will be similar. The fact that two widely different grinds are used interchangeably also tends to substantiate the results of this investigation. These statements assume, however, that the grind is the only variable involved.

Mr. McDowell:—In connection with Mr. Howe's remarks, I believe there is a certain amount of evidence that in certain operations an underburned brick shows less spalling than a well-burned one. Le Chatelier seems to have observed something of that kind for in one of his papers he says, in effect, that a light-burned silica brick is mediocre, a hard-burned brick is good, but a medium burned silica brick is detestable.

Mr. Greaves-Walker:—Is it not true that to make a better silica brick we have been attempting to get 100 per cent tridymite-cristobalite content, which would mean a hard, dense brick, possibly the densest silica brick we can make, in order to make it stand up longer under thermal shocks?

Mr. Howe:—There has been a decided tendency to burn harder and the results obtained in practice seem to justify the extra expense when the brick are exposed in service to the highest temperatures. At lower temperatures, however, hard burning is of no advantage and may sometimes be a disadvantage. These conditions are proven by the fact that hard burned silica brick give very good service in open hearth roofs and coke-ovens when compared with those which are light burned. On the other hand light burned sand rock brick give extremely good service in furnace roofs where lower temperatures are involved. Thus the problem of spalling is by no means simple and the success or failure of a given type of silica brick will depend entirely upon conditions.

Mr. McDowell:—The present tendency to burn silica brick at high temperature has come about from the desire to eliminate, so far as possible, the residual expansion and was not based on the effect upon spalling.

Mr. Greaves-Walker:—I think that was also taken into consideration. If you get increased inversion, you would reduce spalling.

MR. McDOWELL:—I do not believe that has been done commercially.

MR. GREAVES-WALKER:—Dr. Endell, what is the German experience with silica brick, so far as spalling is concerned, between the light burned, medium burned and hard burned brick?

DR. ENDELL:—In our own steel plants we have only hard burned brick, burned in the same manner as burned here; and, as far as I know, they are using only hard burned silica brick for open hearth furnaces.

MR. GREAVES-WALKER:—Do you notice any difference between the hard brick and the soft brick, so far as spalling is concerned, and the resistance to thermal shocks?

DR. ENDELL:—I have not made a special investigation of spalling but I believe the spalling of silica brick depends on the amount of quartz, and this depends upon the burning temperature.

MR. McDOWELL:—The light burned brick, such as we have been speaking of, would contain considerable quartz and not a great deal of cristobalite. It is probable that, so far as spalling is concerned, cristobalite is more harmful than quartz. I believe the thermal expansion curves of the two minerals would bring one to this conclusion.

FIRE CLAYS OF IOWA

NOTE BY PAUL E. COX

Milton F. Beecher[1] has made the only investigation on Iowa fire clays. Mr. Beecher did not find any fire clays in Iowa worth exploiting. Iowa has coal measure clays, many of them having been used in stoneware manufacture. The clay at Sargeant's Bluff in the western part of the state is the most refractory but it is not a refractory clay.

There is no reason to believe that Iowa will produce refractories.

DISCUSSION[1] ON "DATA ON OPERATION OF A CONTINUOUS TUNNEL KILN AT THE PLANT OF THE A. C. SPARK PLUG COMPANY, FLINT, MICH."[2]

MR. STAUDT:—I have had considerable experience with kilns, including a tunnel kiln which was not satisfactory and had to be torn down.

My experience with the tunnel kiln cost me good money, but I do not regret it as it proved to me that it is necessary to have a small tunnel kiln for small ware that requires very accurate firing both as to color and size. Such a kiln may not be so efficient so far as fuel economy goes, but it does

[1] *Trans. Amer. Ceram. Soc.*, Vol. XVII, 102 (1915).

[1] Whitewares Division, St. Louis Meeting, Feb. 28, 1922.

[2] McDowell and Helser, *Jour. Amer. Ceram. Soc.*, **5**, 267 (1922).

the work and saves in the quantity rejected. It is my opinion that you should have a big kiln for big ware and a small kiln for small ware.

MR. GOODWIN:—How do they determine the heat, when passing through the different zones, with cones?

MR. McDOWELL:—The cones on any of the cars may be seen at any time from the open entrance to the tunnel. The fireman, knowing at what position in the hot zone he can expect the maximum heat, can, therefore, use the cones as a close check on the pyrometer.

MR. SCHRAMM:—Was the temperature gradient along the length of the kiln determined with a long thermocouple?

MR. McDOWELL:—Yes. The temperature was read from a thermocouple extending up thru the bottom of a car to the level of the ware. This couple was attached to the pyrometer all during its travel thru the kiln, and readings were taken every foot of length.

MR. KLEIN:—Have you any way of measuring the temperature of the arch in the hot zone?

MR. McDOWELL:—None except our pyrometer readings. The thermocouples extend through the arch and into the kiln six inches. These thermocouples show a temperature of 1440°C.

MR. KLEIN:—Has the arch ever been replaced?

MR. McDOWELL:—The arch has never been touched.

MR. SCHRAMM:—The good results reported by the authors, and especially their success in firing without saggers, are to be attributed chiefly to close control over firing conditions. The earliest work on surface combustion was done in this country by Professor C. E. Lucke; later, Bone, in England, independently developed furnaces working on this principle. For a time there was considerable speculation as to the nature of the process. In an early type of furnace, the mixture of gas and air under pressure was fed into a bed of granular refractory material within which combustion took place. Unusual results were obtained in the way of attaining high temperatures with a minimum consumption of gas. Among the factors contributing to this were:

1. Thorough mixing of the gases in passing through the bed.
2. Acceleration of combustion, due to contact between gas and solid.
3. The storing up of heat in the refractory bed and its emission in radiant form.
4. The "baffling" action of the refractory which permitted the gas-air mixture to be fed under considerable pressure without blowing out.

The net effect of these conditions was to permit complete combustion without excess of air, giving high efficiency, and to increase the amount of gas that could be burned in a given combustion space, promoting high temperatures. In the commercial application of these principles it has been found necessary in many cases to abandon the use of the refractory

bed, and to that extent to return to ordinary methods of firing, in which surface action is by no means absent. However, it would seem that so long as it is possible to achieve complete combustion of a theoretical mixture of gas and air, the chief advantage of the new system has been retained.

MR. A. W. BUCKINGHAM:—Two features of this kiln illustrate a tendency in present day kiln construction which make for better control:

First, the cross section of the kiln is as small as possible, consistent with the production required.

Second, the large number of burners in the firing zone undoubtedly permits considerable flexibility in "soaking" time.

Several points have occurred in reading over this paper which we believe the authors should have brought out:

What is the approximate cost of the different kilns?

MR. P. D. HELSER:—Due to the fact that both kilns were built during a period of high prices, the replacement cost at the present time can only be approximated.

The approximate replacement cost of the smaller kiln would be $10,000, while the corresponding figure for the larger kiln would be $20,000.

MR. A. W. BUCKINGHAM:—It is natural to suppose that heating up and cooling down a tunnel kiln would cause more or less wear and tear on the structure. The authors state that after two years of operation there has been very little damage to the kiln on account of this intermittent operation. To what particular features of the construction or operation do they attribute this?

MR. P. D. HELSER:—Small size, simple construction, and the nature of the refractory materials used in construction, are the factors which account in large measure for the slight damage.

MR. A. W. BUCKINGHAM:—The width of the kiln is given in the paper but not the height of the crown of the arch above the deck of the kiln car. It would be interesting to know how much space there is above the material being fired.

MR. P. D. HELSER:—This must necessarily depend upon the nature of the fuel and the difference in volume of the resulting combustion products.

MR. A. W. BUCKINGHAM:—Drop arches in the preheating zone should serve as effective baffles provided they extend down fairly close to the deck of the kiln car. How much below the crown of the main arch do these baffles extend?

MR. P. D. HELSER:—This depends upon the nature of the ware fired and its ability to withstand rapid preheating.

MR. A. W. BUCKINGHAM:—Manufacturers of this grade of ware would be interested in learning what the unit fuel consumption is, that is, cubic feet of gas per ton of ware, etc.

Mr. P. D. Helser:—The only ware burned in these kilns in quantities has been spark plug porcelain insulators. On this account figures on no other types of ware are available, and a comparison on a tonnage basis would obviously be meaningless.

Mr. A. W. Buckingham:—The method of taking temperatures for the full length of the kiln at twelve minute periods is a novel one and certainly should be very accurate. Do the authors suggest this as being a practical method of taking temperatures at frequent intervals throughout the day?

Mr. P. D. Helser:—Yes, it serves as a very satisfactory check.

Mr. A. W. Buckingham:—The second installation is described as being about twice the width of the smaller one. What is the total burning time in the longer kiln as compared to the twelve hours for the first installation?

Mr. P. D. Helser:—The total burning time is the same in both kilns.

Prof. C. B. Harrop:—For the firing of a shallow layer of small size ware, made from a body mix that will stand rapid heating and cooling, the above described kiln is undoubtedly a real success. However, for capacities such as are being secured from some of the other tunnel kilns firing sanitary ware, general ware and electric porcelain, this type of kiln would be entirely out of the question.

The Surface Combustion firing equipment is probably responsible to a large extent for the success of the kiln. Any other system of fuel application would undoubtedly result in so much greater volume of combustion gases that the temperature at the charging end of the kiln would be excessive and serious damage would occur to the entering ware. The Surface Combustion principle of firing gives an intense temperature in a restricted space which is absolutely necessary in a kiln of this length.

If the authors had given more real operating data, their paper would be of far greater practical value. It would be very interesting to know:

(a) Tonnage or number of pieces fired per 24 hours.
(b) Cubic feet of gas required per 24 hours.
(c) Total power required to operate the kiln.
(d) Labor required to operate the kiln.
(e) Cost of repairs—average over a long period.
(f) Approximate total cost of kiln.

Mr. P. D. Helser:—This kiln was designed for the purpose of burning one special type of ware to a comparatively high temperature. The kiln has given entire satisfaction for the purpose intended, and no extensive investigations on the firing of different types of ware have been made.

The kiln was designed and built to meet our special need, with no idea of further exploitation, therefore nothing was to be gained by giving it undue publicity.

While the Surface Combustion firing equipment is considered a successful accessory to the operation of the kiln, any efficient premixing device

delivering a correctly proportioned mixture of air and high-flame-temperature fuel would answer the purpose.

In fact, on account of the varying quality of the gas this Surface Combustion equipment requires constant adjustment to maintain correct combustion conditions and to give a desirable kiln atmosphere which is so essential to insure satisfactory burning conditions in any firing process.

Measurements as made on the larger kiln show a power consumption of fifteen H. P., which includes one H. P. for the pushing mechanism, four H. P. for the cooling fan, and ten H. P. for the operation of the blower furnishing the air for combustion.

The labor required to operate the larger kiln is one man full time, and an additional man one-half time.

The only data available on maintenance cost is that on the smaller kiln which was in operation for over two years. This cost approximated $200.00.

By C. C. Treischel:—The kiln described is a remarkable innovation in kiln building but I believe that its field is very limited, due to the fact that porcelains fired in it must be small and capable of absorbing heat very rapidly. Furthermore, I believe that a multiplicity of designs and sizes, such as is met with in practically every line of whitewares manufacture, excepting spark plug porcelains, would lead to difficulty because of continual readjustment of the control mechanism to meet operating conditions.

There is also some doubt in my mind regarding the relative degree of maturity of the top of the ware and the bottom, that is, in this case the tip of the spark plug porcelain in the one case and the top or large end in the other. It seems to me that the tip being more exposed to the reflected heat in the kiln would be matured more than the larger end which is against the bottom of the tray. This might not be a disadvantage in spark plug porcelains but would be in the case of most designs used in the whitewares industry.

However, the builders of this kiln must be congratulated because they have evidently solved their individual firing problem, which is more than most of us can say for ourselves.

DISCUSSION "THE FIELD OF PORCELAIN GLAZES MATURING BETWEEN CONES $17^3/_4$ AND 20"[1]

By H. H. Sortwell:—Mr. Twells' work was admirably chosen in that it filled a vacancy so that now from the work of Stull, Stull and Howat, the writer, and Mr. Twells closely agreeing data are available on this type

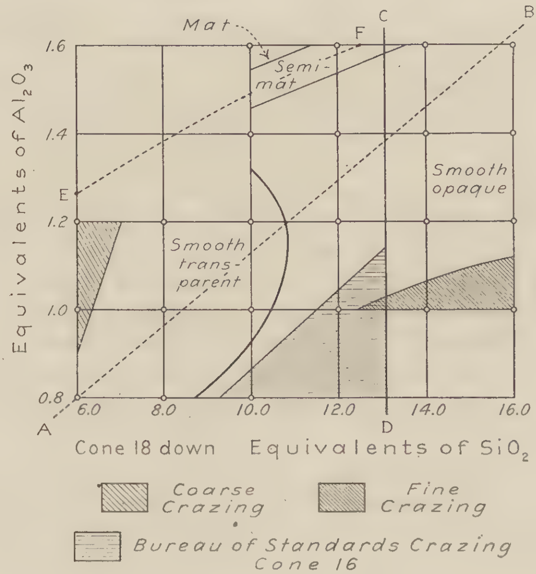
[1] *Jour. Amer. Ceram. Soc.*, **5**, 430 (1922).

of glaze covering the wide range in temperature of from cone 9 to cone 20.

Considering the difference in materials, methods, and medium of firing the agreement of the results from cone $17^3/_4$ to cone 20 with those obtained at the Bureau of Standards is surprisingly close.

Below is reproduced Mr. Twells' Fig. 5 representing his results at cone 18, with the results of the writer in that portion of the field at cone 16 superimposed thereon for comparison.

The dotted line AB which practically bisects Mr. Twells' field shows the location of the glazes designated by the formula $Al_2O_3 = 0.3$ plus $^1/_{12}$



Twells' Fig. 5

AB – $Al_2O_3 = 0.3$ plus $\frac{1}{12}$ SiO_2.
CD – Upper limit in SiO content of Bureau of Standards glazes.
EF – Limit of area of bright glazes at cone 16.

SiO_2 which was derived from the results obtained at the Bureau of Standards and was given as the axis along which the best glazes lie. The line CD indicates the upper limit in silica content of the field of glazes studied at the Bureau, the dotted line EF shows the limit of the area of bright glazes at cone 16, and the horizontal hatching denotes the crazing which occurred at the same temperature. The agreement is evident.

The recession in the crazing area is about what would be expected had the trials been the same in both cases. The coarse mesh crazing noted by Mr. Twells is evidently the type of crazing referred to by the writer as crazing caused by overfiring. It was to be expected that the failure of some

of the high flint glazes to lie down to smooth surfaces reported by the writer, would not occur in the field studied by Mr. Twells. The glazes in which this appeared were very much lower in alumina and were the only glazes in the Bureau of Standards compositions which contained more than 55 per cent flint excepting one of higher alumina content.

Bureau of Standards

DISCUSSION ON "COMPARATIVE TESTS OF AMERICAN AND FOREIGN TABLEWARE"[1]

By H. F. Staley:—Mr. Sortwell has done a very nice piece of work in devising and applying comparative tests to American and foreign tableware. It is very pleasing to learn that American wares show up so well in the various tests in comparison with the foreign makes. This is only one more proof that the manufacturers of ceramic products in this country need not fear public tests of their wares in comparison with those of foreign makes. In every case where a certain quality of ware has been demanded, the American tableware manufacturers have been able to produce it. If comparative tests of any other ceramic product should show that the American material is inferior to the foreign material, we can rest assured that the American ceramic manufacturers have sufficient ability and ingenuity to speedily correct the defect. In other words, the ceramic industries in this country will have nothing to fear from publicity and have much to gain.

AN ACCOUNT OF AN INVESTIGATION OF SOME GEORGIA CLAYS AND BAUXITES[1]

By R. B. Gilmore and A. H. Fessler[2]

Introduction

Through the central part of Georgia, and traversed by the Central of Georgia Railway Company's lines, lies a belt known as the coastal plain containing large deposits of clays and bauxites. Besides this a small area occurs in the northwestern part of the State. These deposits vary from typical kaolins on the one hand to high grade bauxites on the other. The belt is two hundred and twenty-five miles long and varies from twenty to fifty miles in width. They are for the most part surface deposits with very little or no overburden, attaining a thickness in some places of forty feet. Deposits of from four feet to twenty feet are common. The fields have been worked to some extent but never have been developed for the ceramic

[1] Sortwell, *Jour. Amer. Ceram. Soc.*, **5**, 276 (1922).

[1] Published with the permission of the Director of the U. S. Bureau of Mines.

[2] Received July 18, 1922.

trade to the degree to which they are worthy. The railway company realizing this fact, and the great potential wealth of the deposits, is carrying on an extensive investigation of these clays and bauxites through a coöperative agreement with the U. S. Bureau of Mines. The Bureau in turn is coöperating with ceramic industries for making large scale practical tests to confirm the laboratory findings.

The work has been in progress over a year and will be continued to completion. The tests are made on a semi-commercial scale in order to obtain practical data on the value of these materials for commercial purposes. Two ton samples from each of twenty-four of the most typical deposits were sent to the Ceramic Experiment Station at Columbus, Ohio, where tests are being made. The final phase of the investigation will be to put these clays through the commercial practices for which they appear to be best suited as indicated by preliminary laboratory tests.

The clays, roughly classified into two types, are included in the investigation, namely, those suitable for pottery and allied products and those suitable for refractories. The main investigation on the white burning clays consists of developing improved refining methods with the objects in view of eliminating undesirable impurities and producing a more uniform product. In the refractory work, both small and large scale tests are made to determine the behavior of the raw materials under manufacturing practice and the serviceability tests are to be made under actual furnace conditions.

Preliminary Tests

Preliminary tests were first made on the samples to determine the physical properties of these materials in order to indicate the purposes for which they were best suited. The tests included shrinkage, both drying and burning, porosity, burned color and fusion temperature on raw material together with viscosity determinations on the slips. The viscosity tests were made to determine the proper amount of caustic soda to be used in the washing so that the most efficient separation of impurities might be obtained.

Refining Study

Besides a blunger, agitator, filter press, and other auxiliary machinery commonly used for preparing the slip and collecting the washed clay, the clay washing apparatus consists of two elutriating cans and a "whirlpool" clay separator built according to design of Mr. R. T. Stull, Supervising Ceramist of the U. S. Bureau of Mines. This separator is in effect an elutriator in which the slip enters tangentially and near the top instead of through a pipe down the center to near the bottom. A whirlpool action is caused which throws the coarser particles toward the center and down, where they are collected in a container attached to the bottom of the can.

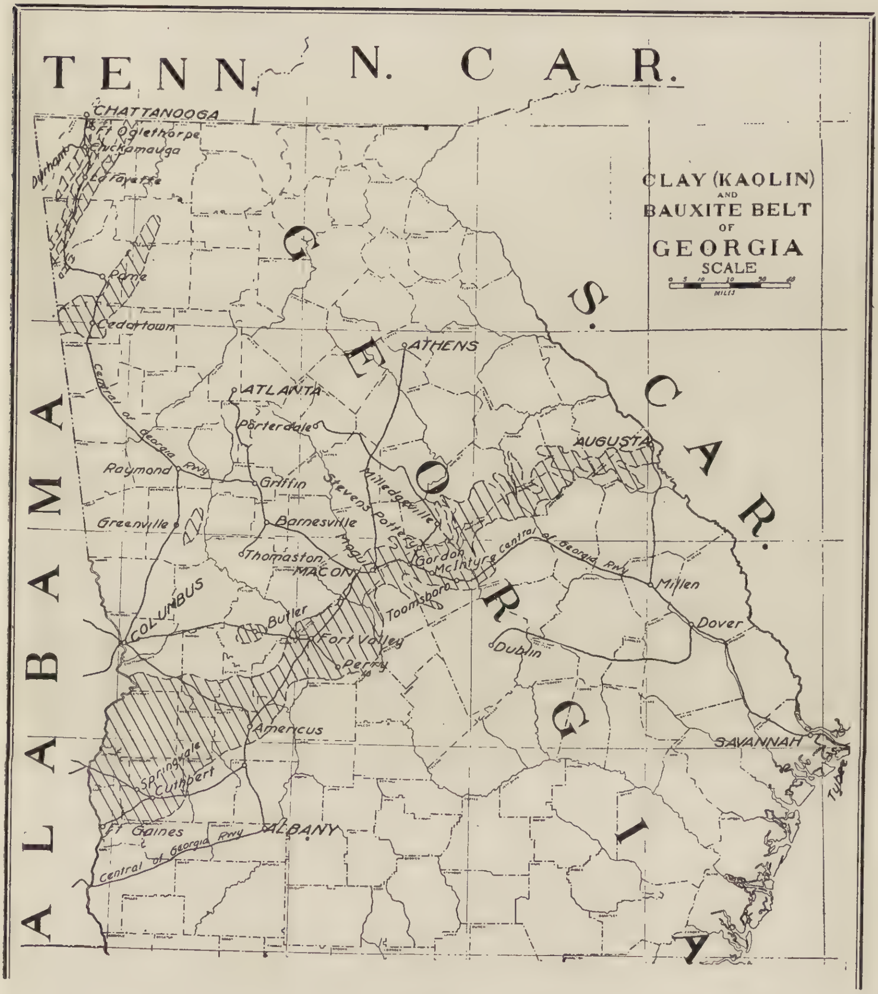

TENN.
N. CAR.
S. CAR.
ALABAMA
GEORGIA
CLAY (KAOLIN) AND BAUXITE BELT OF GEORGIA
SCALE
MILES
CHATTANOOGA
Ft Oglethorpe
Chickamauga
La Fayette
Rome
Cedartown
ATHENS
ATLANTA
Porterdale
AUGUSTA
Raymond
Griffin
Greenville
Barnesville
Thomaston
MACON
Milledgeville
Stevens Pottery
Gordon
McIntyre
Toomsboro
Central of Georgia Rwy
Millen
Dover
COLUMBUS
Butler
Fort Valley
Perry
Dublin
Americus
SAVANNAH
Tybee
Springvale
Cuthbert
Ft Gaines
ALBANY

FIG. 1.

A paper in the *Journal*, giving in detail a description and principles of operation of this separator, will be published later. The elutriating cans are large, each being four feet high, one is three feet and the other five feet in diameter. The capacities are one hundred and sixty-five and four hundred and fifty gallons, respectively. The arrangement is such that the slip after passing through the screens is then passed through the separator, then through the elutriating cans and finally the overflow from the larger can is caught in a seven hundred and fifty gallon settling tank.

A thousand pounds of clay are blunged at which time caustic soda is added to accomplish deflocculation and when blunging is completed the slip is passed through a nest of standard screens, Nos. 8, 20, 65, 100 and 150. It is then pumped into an agitator overhead and run through the washing system, a constant head being maintained to assure a constant rate of flow.

There are five separations derived in this operation after the clay slip has passed the 150 screen. The majority of the impurities are contained in the first one, or the residue in the grit collector of the "whirlpool" separator, while the separate, or material deposited in the settling tank, is in most cases practically free from impurities, consisting almost entirely of kaolinite. The apparatus has produced very favorable results and unless the impurities are in an extremely finely divided state they may be removed, producing a clay which burns to almost a snow white color and free from small objectionable specks. A slight trace of very fine quartz grains in some cases was the only foreign material found in the washed product, when examined under the microscope. The "whirlpool" separator, besides removing the fine grit, also removes the thin mica flakes which are not eliminated under present clay-washing practice. The recovery of valuable clay is also higher.

Such pleasing results have been obtained in some of the samples washed that several hundred pounds of the refined material have been sent to manufacturers making various kinds of white ware in order to test the pottery-making properties of these refined clays in a practical way. The clay will be put through actual commercial practice in the manufacture of pottery, wall and floor tile and electrical porcelain. In this way the working, drying and burning properties may be ascertained in the plastic, dry press and semi-dry press process. This phase of the work is to be of such an extensive nature that complete data on the clays tested may be available for users of white clays.

After the washing investigation has been completed at the Ceramic Station, it is planned to remove the washer to some point in Georgia and continue the work on a practical basis. Work will also be done, either at the Station or in Georgia after the washer has been set up there, on the dewatering of clay slips by methods other than filter pressing. Several

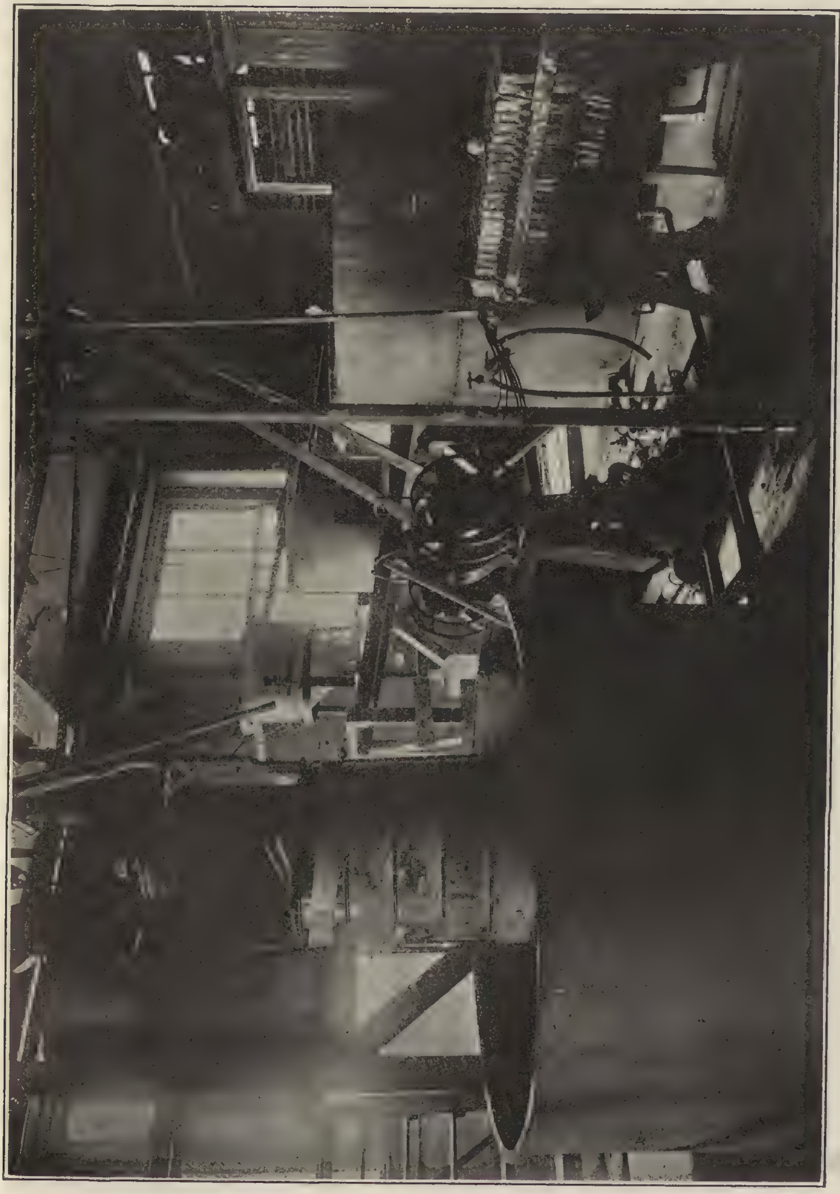


Fig. 2.

Fig. 3—General Bauxite Co., Nadine, Ga.

FIG. 4—Edgar Bros. Co., McIntire, Ga.

work was suggested on account of the fact that filter pressing is comparatively expensive and in exceptional cases appears to render the clay unsuitable for certain purposes.

Refractory Study

Although the refractory study has only been started, sufficient work has been done to determine which clays are particularly valuable for refractory purposes. The laboratory work, thus far, in this connection has been confined largely to fusion, spalling and load tests.

The samples chosen for this study were divided into three classes, those properly classed as (1) clays or kaolins, (2) bauxitic clays, and (3) bauxites. Besides the bauxites, nine clays and five bauxitic clays seemed worthy of investigation for refractory purposes. To supply the grog for the refractories made from clays (Class 1), samples of these clays were calcined to cone 14 and ground to pass a No. 10 mesh screen. Sixty per cent of each grog thus prepared was mixed with forty per cent of the same raw clay to serve as the bond. Bricks of the standard size were made of these mixtures by the dry press process and burned to cone 14. The porosities were determined on the whole brick by the gas expansion porosimeter and the bricks subjected to the standard spalling test. Ten quenchings were made and the loss in weight taken as an indication of the resistance to sudden temperature changes.

Load tests at furnace temperature were also made on some of the fire-brick which indicated remarkable resistance to spalling. Some phenomenal results were obtained in the load tests and in two cases especially the results of the spalling tests were far above the average fire brick, the spalling loss being less than 0.60 per cent. In the fusion tests not one of the samples gave a fusion temperature below cone 34, approximately 1740° C or 3164° F.

The samples of bauxites and bauxitic clays were made into bricks in the same manner except that the grog samples were calcined to cone 17. Because the raw materials were low in plasticity and bonding strength, one of the clays of good plasticity which had given high scores in the fusion, load and spalling tests was selected as the bond. Seventy per cent of the calcined material was mixed with thirty per cent of the bonding clay molded dry press and burned to cone 16.

The clays which showed exceptionally good results in these tests will be tested in a practical way on a much larger scale. A carload of one of the most promising clays has been shipped to a well known fire-brick plant where it is to be made up into standard refractories. Arrangements have already been made to test these refractories for locomotive arches, malleable iron furnace bungs and electric furnace linings. A sample of bauxite

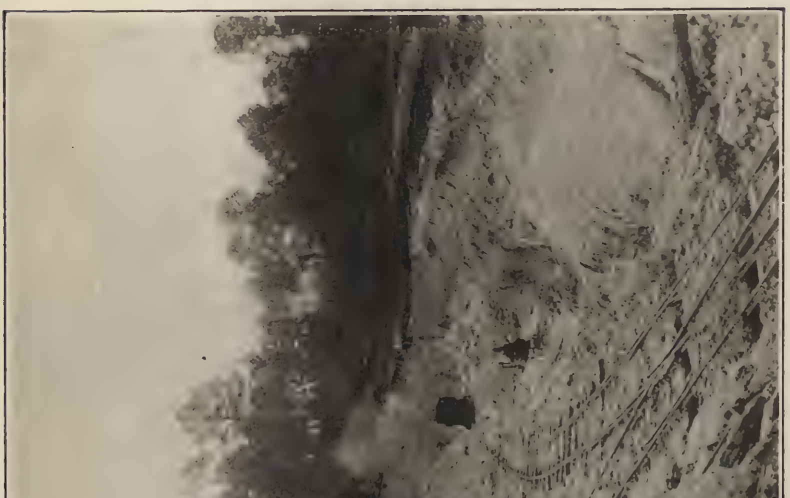


FIG. 5—Savannah Kaolin Co., Gordon, Ga.

has been sent to the Bureau of Mines Experiment Station at Seattle, Wash., where it is to be sintered, made into refractories and tested as a lining in an electrically heated high temperature metallurgical furnace. Although the work at present time has not been completed, enough has been done to indicate the ceramic possibilities of this extensive belt of clays and bauxites.

COLUMBUS, OHIO.

ACTIVITIES OF THE SOCIETY

Increase in Membership Support

Twenty personals and five corporations is the gross score for August. There has been the normal loss (1 associate) this month. The net increase in members for the first seven months of this calendar year is:

	Personals	Corporations	Total
August 10, 1922	1509	188	1697
January 1, 1922	1350	139	1489
Net Increase	159	49	208

The membership status and gains for the past five years are here shown:

	Record		Increase	
	Personal	Corporation	Personal	Corporation
February 1917	537	None		
February 1918	717	33	180	33
February 1919	911	73	194	40
February 1920	1133	94	222	21
February 1921	1243	105	110	11
January 1922	1350	139	107	34
At Present Time	1509	188	159	49
		Total	982	188

It is remarkable that in the years preceding the present, practically all of the additional membership support was secured during the later months of the year. This year there has been a steady net increase, in fact the membership has steadily increased since the Society has had a full time secretary, not directly because of his activities but because of the larger service which the Divisions and standing committees have rendered.

The gross increases in membership by periods since June last year are:

	Personals	Corporations	Total
1921 June to September	41	11	52
Sept. to December	18	2	20
Dec. to February, 1922	136	21	157
1922 Feb. to May	81	10	91
During May	13	13	26
June	13	5	18
July	25	11	36
August	20	5	25
Gross Totals	347	78	425
Loss	81	5	86
Net increase	266	73	339

The average monthly gross addition from June to June was a little better than 25 personals and 5 corporations. During the past summer months there was a falling off

in the "batting average" of the team as a whole notwithstanding the large scores made by A. F. Hottinger, B. E. Salisbury, O. O. Bowman, 2nd and C. E. Bales.

The team is now getting into its winning stride; things are getting back to normalcy. If history will repeat, and it always does with those who are in earnest, our present team of 1697 members will from now on run up a much larger average each month. Our team has always played better and more consistent in the fall and winter months; indeed with increasing monthly averages.

A statistician would figure from the "laws of averages" in our case, that a reasonable expectancy would be a net increase of 200 personal and 100 corporation members during the next three months. This would be based largely on the more general coöperation now being shown by the individual members, and by the more active and efficient Division organizations.

A. F. Hottinger

B. E. Salisbury

The following shows the hitters, and the scores made by each, during the months of July–August.

		Personal	Corporation
R. R. Danielson; P. D. Merica; W. S. Williams; W. M. Clark; W. A. Hull; H. H. Sortwell; J. W. Cruikshank; D. H. Fuller; R. F. Segsworth; August Staudt:	1 each	10	..
C. E. Bales; G. R. Truman	2 each	4	..
Mrs. Arthur F. Weaver		3	..
O. O. Bowman, 2nd		1	2
A. S. Zopfi		..	2
Secretary's Office		2	1
		—	—
		20	5

The Society is now doing more real constructive work than at any time in the past; the Industrial Divisions and the committees are functioning, not 100%, but consider-

ably more than at any time heretofore. We can continue with the larger and more interesting *Journal* if the members secure the required financial support.

The business of the Society is being handled as economically as is consistent with making progress. The Board of Trustees has proceeded on the policy of making an article for which there is a demand, then showing it, and in all legitimate ways promoting it.

The service rendered by the Society is measured by the *Journal* but it is not altogether the *Journal*. The original papers, the discussions and the abstracts published in the *Journal* are the records of results achieved. The prime service of the Society, making the *Journal* possible is the research promotion and education, decentralized through the several Industrial Divisions, but on a coördinating program.

The Society at the present time is solvent with $12,402 cash (or Liberty Bonds) and $4,098 account receivable. These figures do not include inventories of Transactions, Journals and other publications nor of office equipment. It is not that the Society is financially embarrassed at the present time that new members are required but it is that the expenses are exceeding the income and hence, if the Society is to continue the service it is now rendering, more members will have to be secured.

Even if the income did equal the expenses there would be the same need for vigorous solicitation of additional support, for as the Society continues to serve, the demands and the opportunities for service will increase.

There is no human enterprise, no matter how unselfish and beneficial it is, that does not have to be promoted vigorously if it is to succeed. No Chamber of Commerce, no business man's club, no church or school, and certainly no technical Society can be maintained without continued selling of it to prospective supporters. Our task, therefore, is not for this Fall alone, but for as long as the Society continues. Will each member realize the importance of succeeding with this task that the Society may continue to meet the ever-increasing demand for the peculiar research promotional and educational service for which it is organized?

One hundred and eighty-eight ceramic corporations are now subscribing an annual fee of $25 to the support of the American Ceramic Society that the personal membership may be kept within the financial possibilities of the young men in the plants for whom the educational enterprises of the Society are especially directed. This Society is unique in that the personal subscription has been kept at the low figure of seven dollars and a half. Over 1500 persons are now having the privileges of membership at this low annual fee because of the larger subscriptions paid by corporations by whom the benefits are more largely realized.

Application to industrial problems of results of researches in the fundamental sciences, and of the engineering and technical investigations; surveys of material resources, and processes; standardizing of tests; writing of specifications for materials and products; finding of the most effective process controls; these are the tasks of the ceramic research laboratories. It is such activities as these that the American Ceramic Society promotes and coördinates. This is the modern method of pyramiding scientific facts and theories into industrial processes and products, and at no time more than at present were organized coördinating and promoting services so sorely needed by the ceramic industries. There is an increasing industrial requirement for research work; the federal, state and collegiate organizations are responding; the trade associations are financing; the American Ceramic Society must furnish the clearing house facilities that the work of each of these agencies may be correlated to the largest possible economic advantage. This is why the Divisions and Committees are more active and why the *Journal* has been so largely increased; and, in consequence, these are the reasons for the goal of 200 personal and 100 corporation additional members.

New Members Received from July 13 to August 10

ASSOCIATE

Backus, (Mrs.) Lulu Scott, 451 So. Goodman St., Rochester, N. Y. Head Dept. Crafts, Mechanics Institute.

Branham, Ivan Bundy, 323 So. Chester Ave., Pasadena, Cal. Bachelder-Wilson Co., Los Angeles, Cal.

Harrington, Rufus F., 383 Dorchester Ave., So. Boston, Mass. Hunt-Spiller Manufacturing Corporation.

Hartshorn, Theodore D., Kensington, Md. Ceramic Division, U. S. Bureau of Standards.

Hebden, James B., 1415 Brook St., Louisville, Ky. Louisville Fire Brick Works.

Beggs, F. M., Tiffin, Ohio. United States Glass Works.

Keese, A. W., 16220 Saranac Road, Cleveland, Ohio. The Collinwood Shale Brick & Supply Co.

Kidder, C. Paul, Klondyke, Ohio. Patterson Foundry & Machinery Co.

Lathrop, John Sherman, 603 So. Louisa St., Glendale, Cal. Tropico Potteries.

Matson, J. Burnett, 705 S. Walnut St., West Chester, Pa. Mechanics Institute, Rochester, N. Y.

Merian, Frederic, 3415 Iowa Street, Pittsburgh, Pa. J. W. Cruikshank Eng. Co.

Mudge, William A., International Nickel Co., Huntington, W. Va.

Murray, John C., 66 Barrie St., Kingston, Ont.

Niece, Norman L., Box 348, Arnold, Pa. American Window Glass Company.

Pendergast, W. L., 1775 California St., Washington, D. C. U. S. Bureau of Standards.

Shegog, Thomas A., 167 West 130th St., New York City.

Spencer, Charles D., Nela Park, Cleveland, Ohio. National Lamp Works of G. E. Co.

Thayer, Florence E., 8 May St., Worcester, Mass. Supervisor of Drawing, Worcester, Mass.

Watkins, Jack H., Charlotte C. H., Virginia.

Woods, B. J., Dubuque, Iowa. U. S. Bureau of Standards.

CORPORATION

Baker Bros. Glass Co., Okmulgee, Okla. (W. G. Baker, Pres.)

Chicago Retort & Fire Brick Co., 208 So. LaSalle St., Chicago, Ill. (John H. Cavender, V. P.)

Golding-Keene Co., Keene, N. H. (Charles E. Golding.)

Thomas Maddock's Sons Co., Trenton, N. J. (C. S. Maddock, Jr.)

Sunflower Glass Co., Sapulpa, Okla. (Frank Bostock, Pres.)

Who's Where in the American Ceramic Society

James M. Bonner, formerly of the Zwermann Co., Robinson, may now be found at Abingdon, Ill.

Arthur L. Donnenwirth, who graduated from the Ceramic Dept., O. S. U., in June is now located at Kenova, W. Va., with the Jeffery-Dewitt Insulator Co.

Gerald Fitz-Gerald, formerly of the Maxon Furnace & Engineering Co. can be found at 20 Hockley Hills, Gem Building, Birmingham, England.

Herbert Forester, of the Veritas Firing System, Cleveland, Ohio, has moved to a suburban home on Bassett Road, Bay Village, Ohio.

G. W. Greenwood, who is secretary and a director of the United Refractories Co.,

is also Resident Manager of Curwin's Accountancy Co., Inc. with headquarters at Wilkesbarre, Pa.

Mokiji Ichijo, a graduate of O. S. U., can now be addressed in care of Japanese Consulate General, 165 Broadway, New York City.

F. A. Kirkpatrick, has left the Jeffery-Dewitt Insulator Co. of Kenova, W. Va. and is at present on a vacation in Unionville, Mich.

P. William Lee, formerly located at 395-14th Ave., Columbus, Ohio, is now at 3401 Race St., Denver, Colo.

E. H. Lintz, of the Jewett Refrigerator Co., Lackawanna, N. Y., is now living at 404 Baynes St., Buffalo, N. Y.

Paul Niegsch, of the Porcelain Enamel & Mfg. Co., is living at 2437 Parkwood Ave., Baltimore, Md.

James G. Phillips, formerly of the U. S. Bureau of Mines, Columbus, Ohio, can now be found at 515 Cottage Ave., Piqua, Ohio.

W. C. Stief, has been changed from The Floretine Pottery, Cambridge, Ohio, to The Mt. Clemens Pottery Co., Mt. Clemens, Mich.

William C. Snowden, has moved from Sheffield to Stockton-on-Tees, England.

Wlbur Stout, with the Ohio Geological Survey, formerly addressed R. F. D. 1 is now located at 154 Erie Road, Columbus, Ohio.

W. F. Wenning, of 3313 Allendale St., has changed to 3447 Allendale St., Pittsburgh, Pa.

H. G. Willetts, of the Willetts Company, has asked that his mail be sent to P. O. Box 1047, Pittsburgh, Pa.

Northern Ohio Section of American Ceramic Society Minutes of the Fifteenth Meeting

The 15th meeting of the Section was held Tuesday, June 6, 1922, in the rooms of the Cleveland Engineering Society, Hotel Winton, Cleveland, Ohio, with an attendance of ten members. Various matters pertaining to the welfare of the Section were discussed informally before and during lunch, which was served at 1:00 P.M. The only matter acted on officially was the appointment of a representative on the Society's Nominating Committee, the Secretary being unanimously chosen.

The afternoon was devoted to an inspection of the canal road plant of the Cleveland Builders Supply and Brick Company, the trip being made by automobile. This plant is very modern and produces high-grade face brick from local shale. There are eleven rectangular, down-draft kilns, each holding about 150,000 brick, and the daily production is 55,000. Each kiln is 17 x 90 feet in size, and has 22 fire boxes, coal being the fuel used.

Mr. E. E. Roll, who has general supervision of the kilns at all the plants of the company, explained new improvements which he has devised in firing methods, resulting in a marked decrease in coal consumption. The Section is greatly indebted to him for his kind interest, also to Mr. J. F. McKay, plant superintendent, whose delightful hospitality added much to the success of the meeting.

A. F. GORTON, *Secretary.*

Third Conference of the International Union of Pure and Applied Chemistry

The third conference of the International Union of Pure and Applied Chemistry was held at Lyons, France, June 27 to July 2 under the presidency of Dr. Charles

Moureu. Twenty-three countries were represented at the meetings. America was represented by the following delegation, C. L. Parsons, E. W. Washburn, H. S. Washington, R. B. Moore, Edward Bartow, and W. D. Bancroft, members of the Council, and Messrs. W. A. Noyes, A. C. Langmuir, John Frazer, Atherton Seidell, and A. P. Matthews, members of the General Assembly. Three meetings of the Council and two meetings of the General Assembly were held. The sessions were interspersed with committee meetings, social events, scientific lectures and numerous excursions to factories in Lyons and vicinity. The visiting delegates and their ladies were royally entertained by the people of Lyons and the meeting was in every way successful and will be long remembered by all present.

At the final session of the General Assembly, Sir William Pope was elected President for the ensuing three year term and it was voted to hold the next meeting of the Union in the Summer of 1923 at Cambridge, England. After the adjournment of the Conference, the delegates were the guests of the Lyons Committee on a steamboat excursion down the Rhone to Avignon whence the delegates proceeded to Marseilles where they were the guests of the French Society of Industrial Chemistry at its annual meeting and where they had the opportunity of visiting the French Colonial Exposition.

The following committee reports which were adopted at Lyons are of especial interest to members of the American Ceramic Society.

Report of the Committee on National and International Fuel and Ceramic Research Laboratories

The committee made the following recommendations:

1. Each country belonging to the Union shall be invited to establish, through a committee or other suitable agency, a systematic nomenclature for fuels, and legal and commercial definitions of the various combustibles together with an exact description of their various properties, physical, chemical, physico-chemical and organoleptical.

2. Through the same agency each country shall also make a complete compilation of the methods and apparatus of research, analysis, and testing, which are employed in the country, either officially or commonly, to the end that this information may be available as a basis of discussion for formulating, ultimately, a set of standard definitions and methods which shall be internationally adopted.

3. In order to facilitate the exchange of information the Committee requests that the committee or other agency established in each country shall correspond directly with the President of the International Committee on Fuels.

Report of the Committee on an International Definition of the Term "CERAMIC"

The committee had before it an excellent French translation of the report of the American Ceramic Society's Committee on Definition of the Term "Ceramic." This report was printed and placed in the hands of all the delegates in attendance at Lyons. The committee approved unanimously the recommendations contained in this report and voted that it serve as the basis of discussion of the question which should be brought before the next meeting of the Union for final consideration, after each country belonging to the Union had had an opportunity to study the report and contribute to the discussion.

Report of the Committee on Chemical Periodicals

The following extracts from the Committee's report are of special interest:

1. All literature references should be given in terms of the abbreviations employed by Chemical Abstracts.

2. The official abbreviation of the word "Japanese" shall be "Japan."

3. All papers shall bear the address of the author or of the laboratory from which they originate.

4. All papers shall be accompanied by an abstract in one of the four languages English, French, German or Italian.

E. W. WASHBURN, *Delegate.*

Report of Research Committee, U. S. Potters Association

The Research Committee reported to the U. S. Potters Association on the progress of its work at the summer meeting held at the Stacy-Trent Hotel, Trenton, N. J., August 2nd.

The first report was made by Mr. Thomas B. Anderson on the use of forced draft burners, for the combustion of natural gas in bisque kilns. From the results obtained it seems that the use of low pressure air in this connection has proven successful from the standpoint of improved burning. More uniform firing is obtained and the heat can be driven to the center of the kiln without over-heating the first ring. Little if any gas is saved and the heat is harder on the kiln mouths and bottoms. There is also more radiation from the kiln walls. The uniformity of the ware and the satisfactory color obtained have justified the installation.

Mr. C. H. Walker reported upon the question of kiln dirt. He advised the use of mechanically stronger saggers, frequent lawning of the glaze, cleaning of the inside of the kiln crown, somewhat slower firing up and cooling, the use of non-flying clay in the wads and the elimination of the sliding of the saggers upon each other, as factors which tend to reduce losses due to kiln dirt. The results from a questionnaire indicated that the life of saggers is on the average from 10 to 13 firings.

Mr. S. B. Larkins reported that a mixture of pottery plaster and white Portland cement, in the proportion of 2 to 1 yields good pottery cases. He also described a satisfactory kiln damper.

Mr. John S. George submitted the results of a questionnaire on lawns and found that about an equal number of rotating and reciprocating lawns are used and that the average capacity of all lawns is approximately 285 pounds per hour, and per square foot. The potteries that use wire cloth employ the 110 or 120 mesh and those using silk lawn the meshes known as IIXX and 12XX.

Mr. F. K. Pence submitted a table in which tests are compiled for the differentiation of the various pottery materials.

Mr. Ira E. Sproat reported upon the properties of three promising clays for the pottery industry, a semi-ball clay from Missouri, a prepared clay from North Carolina and a kaolin-like clay from Tennessee, of considerable apparent value.

He also submitted the results obtained with the use of cobalt sulphate, precipitated with carbonate of soda, as a body stain. He found that a solution composed of 200 ounces of water, 5.5 oz. of cobalt sulphate and 3 oz. of carbonate of soda added to 3000 pounds of body gave the same tint as the regular stain. It was stated, however, that where 60 or more per cent of the water is used over again trouble will occur owing to the concentration of the sodium sulphate which interferes with the casting. It is advised to use only a portion of the water over again or to make up a separate casting body.

Mr. A. V. Bleininger discussed the importance of allowing for the water content of the different body materials and raised the question as to what should be considered a normal water content for each material since it is evident that none of the compositions usually given are based on the use of dry weights. He submitted results obtained at different plants.

The same speaker described also good casting practice and advocated the use of as heavy a slip as possible, with a gravity of 1.8 for the pipe system and 1.78 where

barrels are used. The proportion of soda ash to liquid silicate should be kept in the ratio of 1:2 and under no circumstances should the fluidity of a slip be increased by the addition of water, but only by the systematic addition of the alkaline materials.

The reports of Messrs. Larkins, George, Pence and Sproat were read by the chairman. The latter then submitted to the Association the plan of the AMERICAN CERAMIC SOCIETY to conduct a comprehensive research on saggers as outlined by Mr. Treischel at the St. Louis meeting of the Society. After some discussion the Research Committee was instructed to prepare a reply to the Secretary of the Ceramic Society and to recommend a course of action.

The chairman next discussed the tests of pottery adopted tentatively in conference with the Bureau of Standards and the additional work now being done on this subject in Washington. It was pointed out that such tests are not only of importance in classifying pottery but can be made to serve in plant practice in assisting to maintain constant quality and to test out the glaze fit.

The chairman emphasized the need of determining accurately all the physical properties of American pottery and the materials used, such as the heat expansion of body and glaze, the effect of glaze fit upon the mechancial strength, the resistance of the glazes to abrasion, etc., and it was suggested that the Association enter upon an investigational program along these lines in coöperation with the Bureau of Standards. The Association then voted an amount not exceeding $3000 for the inauguration of such a research at the above Bureau.

A. V. BLEININGER, *Chairman.*

We Thank You

"If we satisfy, you tell it to others; if we do not, please whisper it to us," is a well known pert advertising phrase.

We get many a whispered and sometimes a shouted criticism of what we have done that we ought not to have done, or have left undone that we ought to have done. A paragraph like the following, therefore, comes like a double mint ice cream soda with two straws, on an August day in central Ohio.

> "Enclosed you will find personal check payable to the Society for membership dues for the year 1922.
>
> Your kind letter July 31st received and I wish to thank you personally for sending me the June number of the *Journal*. I received many times the value of the membership in this one issue alone. I certainly wish that the back numbers and the coming issues be forwarded to my office address.
>
> Wishing you personally and the Society in general unlimited success and trusting you will have an enjoyable outing with your fellow workers this summer. It will be a glorious trip and one that I would certainly enjoy if it would be my good fortune to go."

Such a message refreshes us, makes us feel good all over, and enables us to go back to work with zest.

A Step toward Coöperation

Mr. Ross C. Purdy, General Secretary,
American Ceramic Society,
Columbus, Ohio.

My dear Sir:

I have delayed answering your letter of June 30 until I could get time to read over the pamphlets that accompanied your letter.

I am extremely interested in the subject matter of your letter and of the pamphlets, and particularly that which relates to coöperation of your Society with state geological surveys.

The North Carolina Geological and Economic Survey, through its geological and mining division, is taking up particularly investigations relating to clay, feldspar and quartz deposits of North Carolina. In connection with these investigations we have immediately realized the need of a ceramic laboratory. At the present time there is not, as far as I know, a fully equipped ceramic laboratory in the South; and as Director of the North Carolina Geological and Economic Survey, I am very anxious to arrange to have established here at the University of North Carolina, with which the Survey is associated, an up-to-date and complete ceramic laboratory which will enable us to thoroughly test our clays and feldspars; be able to test out all types of mixtures for pottery, tile, terra cotta, firebrick, and common brick, etc. There are many problems in connection with the clays of this State that need to be worked out, and I want to be in a position to work them out within the State. A ceramic testing laboratory, if erected at the University of North Carolina, could and probably would be used by nearly all the Southern States.

Dr. Ries of Cornell University has done considerable work for this Survey on the clays of North Carolina; as has also Mr. Watts of Columbus. We hope to have associated with us within the next year, a geologist who is thoroughly acquainted with clays and clay products. We are also associating with us men who are thoroughly familiar with the technical side of the ceramic industry.

I can assure you that we shall be very glad to coöperate with your Society in every way possible.

Would this Survey be eligible for membership in the Society; and if so would it be under the head of Corporation Members?

Yours very truly,

(Signed) Joseph Hyde Pratt, *Director*

SUMMER MEETING
THE CANADIAN TOUR

An Account of the Summer Excursion Meeting Aug. 13–20, 1922

By Alexander Silverman

The writer has been requested to prepare an account of the Summer Convention, just ended. If he becomes sentimental, or follows the flights of his fancy at times, it is only because he has had the fortunate privilege of being a party to what may unhesitatingly be termed the "most wonderful" tour ever afforded a group of technical men. "Perfection" is the only qualification which will properly fit the "Canadian Tour." Not a drop of rain marred the excursion. It was attractive technically, educationally, historically, scenically and gastronomically. About sixty members and their guests constituted the party.

Through arrangements made by Dr. E. W. Tillotson, the Eastern Ohio, West Virginia and Western Pennsylvania contingent boarded a special car in Pittsburgh on the Buffalo, Rochester and Pittsburgh Railroad at 10 o'clock Sunday morning, August 13th, in charge of Mr. Herrick, Asst. Passenger Agent of the road. Within an hour all were acquainted with each other. A word should be said here of the welding influence of our good friends, Mr. and Mrs. J. G. Kirk of New Castle, Pa. Arrangements were made by the railroad for taxicab and bus service at Rochester, where the group was conveyed to the steamer landing.

At this point members of the Society from other districts joined the party, which boarded the steamer "Kingston." Here was the first evidence of the perfection and detail with which the tour had been planned by our worthy Secretary, Dr. Ross C. Purdy. Transportation had been provided and rooms were available at once on a boat which was crowded beyond its cabin capacity. Sunrise found us in the much-heralded Thousand Islands, and at 10 o'clock we transferred at Prescott, Ontario, to the "Rapids Prince," which conveyed us through Long Sault, Coteau, Cedar, Split Rock, Cascade and Lachine Rapids, with their accompanying scenic beauty, to Montreal, from whose harbor we obtained a most impressive view of Mt. Royal.

Mr. G. Percy Cole of the Dominion Glass Company, local chairman, had buses at the station, and we were taken to the Windsor Hotel, where it was not even necessary to sign the register; our rooms were ready for us, as they were at all hotels subsequently visited. After dinner, an informal meeting was held, at which plans were formulated for Tuesday's schedule. Messrs. Cole, Johns and others addressed the gathering. Light refreshments and an informal smoker followed.

On Tuesday morning, we were the guests of the Harbor Commissioner on his private launch. After viewing the harbor, which, according to information furnished, is the only one in the world yielding a profit, we visited the enormous municipal warehouse and cold storage plant, which has just been completed. That this plant is conducted on scientific principles, was clear from the humidifying apparatus and ozonizing machinery installed to prevent evaporation, and ensure preservation of food stored in the building. Interesting evidence was furnished us also of the care exercised in the planning of the building, whose floors and walls are built of concrete having a heavy cork interlining for heat insulation. During the afternoon, the party was divided into groups, one of which visited the Consumers' Glass Company, operating semi-automatic bottle machines; and another the Gurney Foundry Company, manufacturing enamelled stoves and signs. A third group motored through the city and environs, visiting McGill University and other points of interest. Evening found us at the banquet table, where we were privileged to hear a most interesting address by the President of the King's Council. He emphasized the need for a correct history of the early relations between Canada, the mother country and the United States, so as to ever ensure friendly relations between our Canadian neighbors and ourselves. Other speakers were President Riddle and Mr. Chapman of the Chapman Engineering Company. Prominent officials of the Province of Quebec were introduced. A formality which characterized this, as well as all subsequent banquets, was the drinking of a toast to the King and to the President of the United States, followed by the singing of the respective national anthems. An interesting feature of the musical program was the rendition of a French Canadian song, "Alouette," whose tuneful melody at once appealed to our party; in fact, was our group song during the remainder of the trip.

Wednesday morning found us aboard two special parlor cars, provided by the Canadian Pacific Railroad, and in charge of Majors Burke and Omannay, representatives of the C. P. R. Mention should be made at once of the solicitude and care given us by these gentlemen, who accompanied the party as far as Kingston. They provided every facility possible, in fact were such an integral part of our group that we were loath to part with them. At 10.20 A. M., we arrived in Buckingham, where ex-Mayor "Bob" Cameron and Mr. N. B. Davis, superintendent of the Derry feldspar mine owned by O'Brien and Fowler, met us with a sufficient number of automobiles to motor the entire party some ten miles into the mountains. The product of the Derry mine is a snow-white feldspar of unusual purity and freedom from foreign minerals. After viewing the mining operations, we were guests at a camp dinner, where a French Canadian quartet composed of prominent business men of Buckingham, entertained us with more

of those delightful French songs. Following the dinner, addresses were made by Dr. McLish, Minister of Mines of the Province of Ontario; Mr. Davis, superintendent of the plant; Messrs. Frechette, Omannay, Riddle, Purdy and Silverman. A further inspection of the mine followed the luncheon, and then the party motored back to Buckingham to the special cars.

Six o'clock found us in Ottawa, the garden city of all Canada. Her magnificent buildings, with their Gothic spires, her canals and waterways, her exquisite natural beauty, can never be forgotten. Messrs. Davis, Frechette, Merkley, and Dr. Keele of the Ottawa Department of Mines, constituted the local committee in charge. Our domicile was the famous Chateau Laurier, than which no hostelry ever had more beautiful surroundings. As soon as rooms had been assigned, the party motored to "Ye Olde Homestead Inn" in Val Tetereau, Quebec, across the Ontario dry line. Dining and dancing were the program of the evening. Later some of our party visited the ceramic laboratory of the Department of Mines and the Victoria National Museum of Ottawa.

Thursday morning included excursions to the famous Eddy paper mills, which manufacture all types of paper and pressed paper products; and the Merkley brick plant, making shale brick and fire-proofing materials. Other members of the party motored about the city and suburbs, viewing the magnificent Parliament buildings, Agricultural Gardens, and additional points of interest.

At 11.40 A. M., we were again on the C. P. R., reaching Verona at 2.30, thence motoring to the Richardson feldspar mine, located in the hills overlooking Thirteen Island Lake. Here Mr. R. F. Segsworth, an attorney from Toronto, interested in the mines, and a real host, together with President Taylor of Queen's University, Messrs. Townsend, Gardner, and members of the Kingston Council, led our inspection of the mine, which produces a high-grade pink feldspar, beautiful white quartzite and other minerals, which were especially interesting to the collectors in the group. Sufficient time was available for some of the party to take a plunge into the crystal clear waters of the lake. Again a motor trip, and at 6.30 westward bound on the C. P. R. to Kingston, the "West Point" of Canada and the seat of Queens' University. Here at 9 P. M., we were the guests of the Kingston Council at a banquet which lasted into the "wee sma' " hours of the morning. The speakers of this occasion were Sir Archibald Howald, Head of the Royal Military Academy; Dr. Taylor; and Msssrs. Keele, Hostetter and Beecher. After the speeches, Messrs. Burke and Omannay of the C. P. R., who had to leave us at this point, were given an ovation. Following the banquet, we were conducted to the town hall to view illuminated memorial windows depicting the principal battles of the late war. Needless to say, we literally dropped into our berths in the special sleepers which carried us to Toronto.

The party arrived in Toronto at 7.30 Friday morning, going immediately to the King Edward Hotel. Toronto's local chairman was Mr. M. F. Gibson, a former pupil of Secretary Purdy, who furnished us with a mimeographed schedule, which indicated another busy day. At 10.30, we were the Harbor Commissioner's guests on several launches, which carried us through the gigantic harbor of the city and out to Toronto's various lake resorts. Our party lunched together at the King Edward, and in the afternoon split into groups, one of which visited the Standard Sanitary Manufacturing Company's plant; another that of the Jefferson Glass Company, where lighting ware is made; and a third motored through the city and visited the Queen's Museum, the University of Toronto, the Parliament buildings and the Exposition grounds. At dinner we were the guests of Mr. and Mrs. Abel Hansen, of Perth Amboy, New Jersey. These genial hosts had already won the love of every member of the party. The speakers were Brigadier General Mitchell, Dean of the Department of Applied Science of the

University of Toronto; and Messrs. Gibson and Riddle. Dean Mitchell outlined plans for a department of ceramic engineering at the University of Toronto, whose development will result in valuable coöperation with the ceramic, glass and mineral industries of Canada. After the dinner, part of the group visited "Sunnyside" (Toronto's Coney Island), and others gathered in the home of Mr. Segsworth, where they viewed the rare collection of paintings, etchings and engravings which he has collected with painstaking care. His art treasures also include precious ceramic and glass specimens.

On Saturday at 8.15 A. M., we left Toronto by boat for Hamilton, arriving at 11. Here Mr. H. F. Dingledine took charge of the party. After a visit to the Canadian Porcelain Company's plant, manufacturing electrical porcelain, and to the Libbey-Owens Sheet Glass plant, lunch was served at the Royal Connaught Hotel. Four o'clock brought sad farewells, and the party scattered, some bound for Canadian lake resorts, others visiting Niagara Falls, en route to their homes.

The Canadian tour furnished evidence of the splendid mineral resources of Canada, of her manufacturing enterprise, and of her real men and women who were our hosts on all occasions. Let me repeat what I have already said of Secretary Purdy. His wonderful eye for detail and anticipation of the comfort of every member of the party made the trip perfect, and never to be forgotten. This article may well be concluded by a psalm dedicated to Canada by one of our party.

"Canada is our hostess: we shall not want.

She motoreth us through green pastures, and leadeth us by rapid waters.

She restoreth our soul.

She guideth us into paths of interest, for our mind's sake.

Though we trail and shoot rapids of death, we fear no evil; her guides are ever with us.

Her grain and her vine, they comfort us.

She prepareth a table before us in the presence of our friends.

She maketh our hearts rejoice.

Surely her goodness and kindness will follow us all the days of our life; and she shall dwell in our thoughts forever."

NOTES AND NEWS

Past President Cullen W. Parmelee Designated as Acting Head of Department of Ceramic Engineering University of Illinois

Biographical Data

Born, Brooklyn, New York in 1874.

Graduated from Rutgers College 1896 with degree of B. Sc., and honors in Chemistry. Also, elected to Phi Beta Kappa in senior year for scholarship.

Editor-in-chief of the College Weekly.

Spent five years as chemist with the New York and Boston Dyewood Co., Brooklyn, New York, manufacturing natural dyeing and tanning extracts.

Returned to Rutgers College as instructor in Chemistry in 1901. Organized the Department of Clay Working and Ceramics in 1903 and was Director until 1916. Served as Associate Professor of Applied Chemistry from 1905–08. Professor of Ceramics 1908–16.

Appointed Professor of Ceramic Engineering at the University of Illinois, 1916. Acting Head 1918–1919. Designated Acting Head of the Department for 1922–23.

Served as Trustee, Vice-president and in 1914–15 was President of the American Ceramic Society. Chairman of the Committee appointed to consider the publication by the Society of a journal which resulted in the Society undertaking that enterprise.

Organized the New Jersey Clay Manufacturer's Association in 1914 and was Secretary 1914–1916.

Secretary of Illinois Clay Manufacturer's Association 1917–

Appointed District Chief for Illinois Industrial Furnace Section, U. S. Fuel Administration, 1918.

Member of the Joint American Foundrymen's Association and Division of Engineering, National Research Council Committee on Molding Sand Research.

Consulting Ceramist for Illinois Geological Survey, 1917–

Chairman Committee on Data, American Ceramic Society, 1922–

Member of American Society for Testing Materials, English Ceramic Society, American Chemical Society, Beta Theta Pi, Sigma Xi.

C. W. Parmelee

Author of numerous papers presented before the American Ceramic Society, also co-author of Report on the Peat Deposits of Northern New Jersey, published by the New Jersey Geological Survey, 1905; and co-author of Further Investigations of Illinois Fire Clays, Illinois Geological Survey, 1921.

Coöperative Research Work of Clay Products Associations

The Eastern and Western Clay Products Associations are joining their support of coöperative research work with the Mellon Institute of Pittsburgh. The purpose of this research work in general is to improve the quality of sewer pipe and to reduce the cost of manufacture. Their aim is to manufacture more uniform and stronger sewer pipe; one also that will better resist the action of sewage chemicals.

Clay sewer pipes have withstood the requirements of modern times in a satisfactory fashion, but it is that the sewer pipe manufacturers may be forearmed to meet the ever-increasing demands and ever increasing severity in requirements that they desire to improve their product, and at the same time manufacture it at lower cost.

Mr. Harry G. Schurecht, a long standing member of this Society, well known because of his researches and writings, is employed by these associations as their Fellow. A very brief sketch of his training is as follows:

Received B.S. in Ceramics at University of Illinois, June, 1914.

Ceramist for The Findlay Clay Pot Company, Washington, Pa. July 1, 1914 to September 1, 1915.

Laboratory Assistant in Ceramics at The U. S. Bureau of Standards, Pittsburgh, Pa., September 1, 1915 to April 1, 1916.

Ceramic Chemist, U. S. Bureau of Mines, Columbus, Ohio, April 1, 1916–April 1, 1922.

Fellow for the Eastern Clay Products Association, and The Clay Products Association, The Mellon Institute, Pittsburgh, Pa., April 1, 1922.

H. G. Schurecht

H. T. Shelley

He has just started upon the latter work, hence we can not at this time make statement as to what problems these associations will be engaged upon first.

G. F. Lenth

We herewith have the pleasure of showing the likeness of Mr. H. G. Schurecht, and also that of Messrs. H. T. Shelley and George T. Lenth.

Mr. H. G. Shelley is managing secretary of the Eastern Clay Products Association, municipal engineer of wide experience and reputation, an organizer, and one with appreciation of the need and benefit of plant control in improving quality and reducing cost of manufacturing of sewer pipe.

Mr. Lenth is Secretary of the Western Clay Products Association. He has had many years' experience as City Engineer, is widely known, and his counsel is sought wherever there are questions regarding the use of sewer pipe.

The American Ceramic Society is always pleased to see such coöperative contacts made, for thus, and only thus will the sum of our knowledge be increased. It brings contact of the collegiate institute with the industry, and the industry with the institute,—a happy and profitable combination.

Tests for Fire Brick

At the last conference, at the Bureau of Standards, with the Advisory Committee on Specifications for Refractories, which is made up of representatives of producing and consuming industries and interested technical societies, somewhat wide differences of opinion were expressed as to the proper test requirements for fire brick for the linings of stoker-fired boilers and it became apparent that a systematic investigation would have to be made before various essential points could be satisfactorily settled. As a result, Mr. Howe has made additional tests of something like forty different brands of fire brick at Mellon Institute, and an extended coöperative investigation has been undertaken at the Bureau of Standards.

At the request of Mr. E. B. Powell, Consulting Engineer of Stone and Webster, approximately forty large power house operators have sent to the Bureau for test, samples of the brands that they are using. By means of questionnaires sent to these power companies, Mr. Powell is collecting as complete information as possible on the service given by all the brands of brick represented. The correlated information will later be compared with the data from the tests. Practically all of the established tests for refractories and some additional tests are to be applied to all the brands received.

Several months will be required to do the work but it is believed that when this investigation is completed the information available from all sources will be sufficient to make it possible to arrive at definite and satisfactory conclusions as to what test requirements should be included in specifications for fire brick for stoker-fired boilers. As the brands of brick included in these tests are used in other types of service as well, the test data can be used in the preparation of specifications for refractories for other specific uses.

Oxidation of Ceramic Wares during Firing

From U. S. Bureau of Mines

In the study of the oxidation of ceramic wares during firing, being conducted at the Columbus, Ohio, Experiment Station of the Bureau of Mines, substantial progress is being made in the investigation of the rate of evolution of sulphur dioxide and trioxide at different temperatures and atmospheres. This work has reached a point where it was deemed advisable to check laboratory work with industrial practice. Samples of flue gases at all stages of the burn were recently collected at the plant of the Fallston Fire Clay Company, Fallston, Pa. Observations of the so-called "blue smoke" were made at this plant.

Calendar of Conventions

With the summer meeting now off of our Calendar of Conventions and already a matter of history, the most important event to plan for is the Annual Meeting in February, 1923. This meeting, which will mark the quarter century of the activities of the American Ceramic Society, is already progressing toward the completion of arrangements.—Notice that in this list this announcement stands out in large type—"There's a reason."

American Chemical Society—Pittsburgh, Pa., September 5–9, 1922.

National Association of Brass Manufacturers—Detroit, Mich., September 6–8, 1922.

Association of Iron and Steel Electrical Engineers—Cleveland, Ohio, September 11–15, 1922.

Eighth National Exposition of Chemical Industries—New York City, September 11–16, 1922.

American Electrochemical Society—Montreal, Canada, September 21–23, 1922.

American Institute of Mining and Metallurgical Engineers—San Francisco, Cal., September 25–28, 1922.

National Association of Commercial Organization Secretaries—Chicago, Ill., October 23–25, 1922.

National Society for Vocational Education—Detroit, Mich., November 30–December 2, 1922.

Dental Manufacturers Club—St. Louis, Mo., November 20, 1922.

Dental Exhibit of the Dental Manufacturers Club—St. Louis, Mo., November 21–24, 1922.

National Exposition of Power and Mechanical Engineering—New York City, December 7–13, 1922.

Mining and Metallurgical Society of America—New York City, December 7–13, 1922.

American Malleable Castings Association—Cleveland, Ohio, January 10, 1923.

National Jewelers Board of Trade—New York City, January 18, 1923.

Canadian National Clay Products Association and Western Ontario Clay Workers Association—Hamilton, Ont., January 24–26, 1923.

American Concrete Institute—Detroit, Mich., February, 1923.

National Association Builders Board of Control—Des Moines, Iowa., February, 1923.

AMERICAN CERAMIC SOCIETY—Pittsburgh, Penna., February 12–17, 1923.

National Gas Association of America—Louisville, Ky., Spring, 1923.

American Institute of Mining and Metallurgical Engineers—New York City, February 19–22, 1923.

National Association of Stove Manufacturers—Richmond, Va., May 9–10, 1923.

American Association of Museums—Charleston, S. C., May, 1923.

BULLETIN
of the
American Ceramic Society

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EDITORIALS

OUR TWENTY-FIFTH ANNIVERSARY CONVENTION

February 12–17 Is the Date and Pittsburgh Is the Place

It was a quarter of a century ago that a few ceramists decided to found a society for the purpose of advancing the ceramic arts and sciences. It was an ambitious proposition then, a little in advance of the industrial demands but results have proven that the pioneer ceramists had a true conception of the industrial needs. What a contrast there is today from twenty-five years ago in the attitude of the factory operators on questions of technical control and research! The charter members of the Society should be given credit for their foresight; for anticipating the demand and for actually being the first and the prompting factor in the development of a demand in the ceramic industries for technical control and research. During these twenty-five years there has been a positive change from resistance to the advances of technical men to a demand for them by the industries that actually exceeds the supply.

Being a natural sequence to the graduation of the first class from the Ohio State University Ceramic Department in 1897 the attention of the Society was most largely confined to promoting ceramic education. The fundamentals of what is recognized today as ceramic science and technology were known to very few. There had been no correlation of the large mass of practical knowledge such as we have today. There were no ceramic

departments in the Bureaus and there were only scattered attempts to apply the fundamental findings of the scientists to factory problems. Much that the students in the ceramic course under Professor Orton were discovering and publishing for the first time is today taken for proven facts, the basis on which to further research.

Twenty-five years ago the Society could be nothing other than an educational institution. All, the plant operators and the scientists alike, had a very great deal to learn through investigations and plant trials. The "researches" of those early days were crude as viewed from the present time. They could not be otherwise for there were no established limits and no directions. It was pioneering even in the outlining of the investigations.

The Ceramic Department organized by Professor Orton was the first effort in ceramic education in this country. There were opposition and prejudice to overcome in establishing the Department of Ceramics at Ohio State University and he did not receive a very general support when, with the other charter members, he organized this Society. The founding of these two pioneer institutions required the mose persistent promotion.

Contemporary with the latter day activities of this Society, the several schools in turn established ceramic departments and the Federal Bureaus began ceramic investigations. To all of these enterprises the Society gave encouragement, moral support and in some instances, political help. A proper tracing of the growth of the Society in industrial influence and as a factor in ceramic education involves a history of all agencies that have added to the total of ceramic knowledge closely associated as they all have been and mutually dependent.

None would be so blind to the facts as to assign credit for the present status of ceramic knowledge and technology to the American Ceramic Society. But all the collegiate and federal ceramic departments, scientific and technical organizations, the technical press and industrial laboratories in this country as well as in other lands have contributed to the fund of knowledge that has been collected during these past twenty-five years. Our sister ceramic societies in England, Germany and elsewhere have been large contributors with the American Ceramic Society, pioneer among them all, maintaining the aggressive lead and doing the larger share.

The celebration of this twenty-fifth anniversary will be more than the observance of the founding of the American Ceramic Society; it will be the commemoration of the first collaboration of industry with the colleges and other research agencies, applying science and scientific methods in the analysis of and adding to the vast fund of practical knowledge already at hand. That collegiate ceramic departments, federal agencies and other ceramic organizations were later organized and have grown in strength and service is a natural sequence. They have given substantial proof that this pioneer Society was founded for a needed purpose.

It seems strange, as we view those early days, that in the light of our present-day experiences ceramic industries did little more than to tolerate the advances made by the American Ceramic Society. In contrast to the indifference of the plant operators in the early years of the Society, the several Trade Associations today are supporting joint researches and a large number of individual plants are employing ceramic engineers and maintaining ceramic laboratories.

This Twenty-Fifth Anniversary Convention will be the occasion for doing more than to establish facts regarding the developments in ceramic technology during the past years; it will be the opportunity for looking squarely at present-day technical and scientific needs of the ceramic industries and for making plans for the collaboration of all on a much more comprehensive plan. In this manner the immediate future will find the ceramic manufacturers ready to meet the more strict specifications of the purchasing public and the ever-changing industrial needs.

The history of the last twenty-five years in ceramic technology and art will be set forth in the January number of this *Journal*. This will be a thorough "Looking Backward" or inventory of the many things acquired during the past twenty-five years. This will leave for the Convention a survey of the present day needs and "Looking Forward."

The Board of Trustees, all standing committees and especially the Divisional officers and committees are making plans that this Anniversary Convention may be occasion for a larger realization of the need for aggressive fostering of technical and scientific research and especially as joint enterprises by industrial associations with collegiate and federal research organizations, as well as by groups by themselves. This should indeed be a profitable event for the ceramic craft.

DISCUSSION[1] ON "USE OF FORCED DRAFT FOR TERRA COTTA KILNS"[2]

Mr. Hottinger:—I am sure we have a new subject, one that has never been brought up in the Ceramic Society to my knowledge, *i. e.*, use of forced draft in firing except possibly on some brick kilns, but never in the terra cotta industry.

Mr. Radcliffe:—Mr. Chairman, about five or six years ago I was doing some work for the Kellogg Brick Company at Peoria. They were making common brick and paving brick. In one of their yards they had considerable trouble in getting the brick hard at the bottom of the kiln so we decided to install a forced draft system on their kilns. We tried it out on one of them that was particularly bad. These kilns were not very well constructed, and had a lot of leaks in them.

They were not able to get more than about fifty per cent of No. 1 pavers, and that burned all the way from nine to fourteen days to finish off the kiln.

This system that Mr. Carruthers describes is known as the Boss system of firing, in respect to method of inducing draft. In the Boss system they put a sewer pipe around underground, and used about one and one-half, or two horsepower for a twenty-eight or thirty foot kiln.

We were able to improve conditions wonderfully. We were able to get No. 1 pavers in the bottom of the kiln and in the center, and we got no over-burning whatever on the top near the bag walls, or any part of the kiln. Previously they were getting over-burned pavers. Sometimes they had to go in with a sledge hammer to get them out. After this, even at the bag walls they got no overburning. They got a percentage increase of twenty to thirty per cent. In other words, they got around eighty per cent No. 1 pavers. They were able to burn the kilns off in six days instead of from nine to fourteen, and they were able to use just the ordinary screenings instead of using fairly good coal. At that time, screenings were worth about fifty cents a ton, while the coal, mine run, was selling at about two and a half a ton. We used screenings entirely for the burn, and of course, made a very considerable saving, and at the same time increased the output of No. 1's, and the brick did not stick together at all. The temperature was very uniform.

Before the forced draft was installed, the smoke and fire seemed to be coming out on all sides of the kiln. They puttied those places up, and thus improved the conditions. As it saved fuel, and brought up the percentage of No. 1 brick, they installed it on all of their kilns. And there you have it. They are using it now, finding it very successful.

I never tried them out on a terra cotta kiln, the reason being that we had a different type of kiln there, and I was afraid of the very point that

[1] Terra Cotta Division, St. Louis Meeting, Feb., 1922.

[2] Carruthers, *Jour. Amer. Ceram. Soc.*, **5**, 449(1922).

Mr. Carruthers brought out; that burning of slack in that type of kiln would clog it up, and would cut down the draft, and so might be dangerous.

However, with the updraft type of kiln, I do not believe it would give any trouble, and it seems to me that it ought to be a very good burning method.

A MEMBER:—May I ask about how many times an hour you have to bait the fire boxes?

J. L. CARRUTHERS:—The fireman makes a coaling round about every fifteen minutes, depending upon the stage of the burn. After firing, he makes several rounds adjusting the draft.

A MEMBER:—I wonder if the whole thing doesn't boil itself down simply into a proposition of getting the fireman to fire more often.

MR. KLINEFELTER:—You know our problem is that in the day time you can usually get your fireman to fire once an hour, and the night man takes it about every two hours and a half. If you could get a fireman to fire every fifteen minutes you could fire all slack coal right enough, but you can not get them to do it. Of course, I can see the advantage of a forced draft; he is forced to fire every 15 minutes.

MR. GATES:—We try to fire about 15 minutes to one-half hour, depending upon the stage of the burning. In the early stages we do not fire as often as we do at high temperatures.

We had a little experience along this same line. We tried the forced draft system of burning about a year and a half ago, but our experience is negative, for some reason we could not make it go.

I can give you all the different kinds of different and conflicting conditions that we ran into. We would burn twice as much coal, and not make any heat, or half as much coal and make a lot of heat.

We never could find out what made it go and what made it stop. The main condition that we had was that of having no grates. We used simply a closed ash pit, and blew the air into it through a funnel. Of course one big difficulty we had was with clinkers, but they didn't bother us generally until we got to the point where they started to fuse. Even on some burns, we didn't have very much difficulty with the clinkers, and so I am of the opinion that if you don't get everything just right, you will have a lot of difficulty with a forced draft system.

We had flames shooting out of the top of the kiln, and we had the stack red hot. We could get the outside of the kiln very hot but we couldn't get the inside of it very hot.

I think that the main part of that difficulty is due to the fact that we didn't get a sufficient amount of air in over the grates. You can regulate that air in through the grates, so you can practically have a producer gas. It would be possible to make this a fairly good grade of producing gas. We saw it one time. We tried that at one time when we were trying to

make heat. We increased our firing, and there was no flame in the stack but the gas came out of the stack and then burned. Our experience was absolutely negative.

MR. HILL:—I am not surprised that Mr. Gates got negative results, because it is my experience that firing is a matter of the kiln design. If a kiln is designed for the other type of firing, it may not necessarily be adaptable to this, because you are changing your conditions entirely.

MR. GATES:—I might say that I believe that the Denver plant is using both the up-draft and the down-draft kilns. I don't know why it didn't work. We fired it not only every fifteen minutes, but every five minutes as well.

MR. MCMICHAEL:—I have visited a lot of places where it is successfully employed.

A MEMBER:—I believe he attributes considerable of the success he had had with this system to these boxes through which the air is introduced under the perforated plates. These boxes are welded absolutely air tight and my recollection is that he said before he got these boxes absolutely air tight, he could do nothing with this system.

MR. E. C. HILL:—This is very likely to happen. There are, though, other factors that enter into this particular question. One of these is the amount of gas you are putting through and the character of the gas.

The practice in an up and down type of kiln, is usually to burn coal which produces a good deal of gas and often that gas and air comes down into the flue and is not consumed at all but up the stack. That point was particularly brought out to me once when we failed to use Pocahontas coal. The fact was it took more coal to finish our kilns that it did with the Indiana coal, bituminous, with high volatile carbon.

In an up and down draft kiln you have a hundred or a hundred and fifty feet of flue to burn those gases through and this gas generated in the fire box finds enough air, and will generate enough heat to bring the kiln along evenly.

MR. RADCLIFFE:—I might say that the first time we made a burn on this we raised the temperature up to about eight hundred degrees Centigrade in 24 hours and then it stopped. We absolutely could not raise it any more. We just kept on firing and after about six or eight hours, it started going up again. It was at white heat on the top of the kiln where the pyrometer couple was, but the brick work down through had not heated, and after the brick had absorbed a certain amount of heat, then the temperature went on down. We found that it was very important to make flue gas analysis to get the proper CO_2 content. In that way you could save fuel by introducing only the proper amount of air.

T. L. CARRUTHERS:—I might add that it is necessary to adapt this system to the particular type of kiln upon which it is used. Likewise,

we have found that one type of coal does not work on all kilns. On some a heavy cooking coal is desirable, while on others a lighter long flame coal works best and on others a combination of the two coals gives best results.

DISCUSSION[1] ON "SOME EXPERIMENTS ON THE FIRE CRACKING OF TERRA COTTA"[2]

Mr. Hottinger:—Mr. Hill has done fine work and his paper contains a number of very important and vital suggestions to the terra cotta business, and I would like to have this paper very thoroughly gone into and discussed.

C. W. Hill:—I agree with the Chairman that we have here a very profitable piece of work. I think that we all realize the extent of this trouble, and the amount of work that is going to be necessary before we really reach definite conclusions, and I want to urge that Mr. Hill go right on the way he is going, because he has started in the right direction; and if anybody else attempts to follow this up as closely as he has, it will mean a lot of duplication of work.

I am especially interested not so much along the line Mr. Hill suggests, *i. e.*, the further investigation of the composition of the body, although undoubtedly that is important, but in a little more extensive work on the rate of cooling with reference to temperature zones.

We have broad indications that terra cotta is more susceptible to changes in dimensions at certain temperatures than others, and that this is true of the strains which relate to certain zones. That is, we can probably cool very rapidly through one zone, directly after the firing, then possibly there is a lower temperature where we have to cool more slowly. Finally, I have the feeling that the temperatures below those indicated in the charts are equally as important as the others. We should know how low we can cool a piece of work before we take it out of the kiln, without subjecting it to the dangers of the atmosphere. I do not think we know this exactly, but the lowest temperature is when all of this dangerous contraction has taken place. If we could determine it, it would be of very practical value.

There is one interesting point in connection with the Crossley and Enterprise clays. We have noticed that the Enterprise clay has changed materially in its properties during the past year, and we have found that the sand content is lower, so that Enterprise clay now is about the same as Crossley clay, and there is a material difference in its physical properties such as shrinkage.

Crossley clay has also changed considerably over what it was a year or

[1] St. Louis Meeting, Terra Cotta Division, Feb., 1922.

[2] E. C. Hill, *Jour. Amer. Ceram. Soc.*, **5**, 299 (1922).

so ago, so that it is possible that some of the conclusions that Mr. Hill drew from his analyses would not necessarily be pertinent at the present time.

I think that we have something here that is of extreme value to us, and I hope that Mr. Hill will carry along not only the lines that he suggested but also the matter of the right cooling, with reference to the special cooling zones.

E. C. Hill:—In regard to the Enterprise clay, I would say that these trials were made more than a year ago from shipments of clay made in 1920. Shipments of this clay, as Mr. Hill (C. W.) says, have shown a marked improvement, particularly in the reduced sand content.

Mr. Mathiasen:—I ran into some dunting last summer, and when we looked for the cause of it, we found that our last carload of sandy clay, which came from Woodbridge had an abnormal amount of free sand. So I was interested in that Pennsylvania sandy clay. I understood you to say that you had the most firecracking with that material, didn't you?

E. C. Hill:—Yes.

Mr. Mathiasen:—Did you find out how much sand there was by analysis?

E. C. Hill:—No determinations were made of the sand content in the clays in Series I. The sand retained on a 200-mesh screen was determined on the terra cotta clays in Series II.

Mr. Mathiasen:—To check up what he said then about this crazing, I understand you think fire dunting comes from free sand.

E. C. Hill:—I think a sandy clay is more likely to firecrack than a non-sandy one; but you can not tell whether it is going to crack or not until you try it. The amount of sand that is contained does not always indicate its character.

Mr. F. B. Ortman:—On the question of the effect of sand in the body in causing cooling cracks, I think it should be noted that the tendency to cool-crack is not always increased in proportion to increase in silica content of the body regardless of the character of the other constituents of the body. It is quite possible that a certain silica content might be perfectly harmless in this respect whereas in another body it would be very detrimental.

On the Pacific Coast, certain companies use bodies of a very open structure in which a very high percentage, in some cases as high as 30% to 35% of a material, known locally as Ione sand, is used. This Ione sand is a mixture of pure china clay and fine-grained silica, in proportions of approximately half and half. In the use of a certain body containing 30% of this material, there would, therefore, be 15% of pure sand, which when added to the silica introduced by the other ingredients of the body, would probably bring the total silica content easily above 20%. I know of such a body to have been in use for two or three years and when upon learning of the high silica content, I made a special effort to look into the

matter of cooling cracks, and much to my surprise, at that time, found that the material manufactured with this body was practically entirely free from any cooling cracks whatsoever, even though no special effort had been made to cool the kilns carefully.

The explanation obviously lies in the fact that the body as a whole was of a very open structure and that the silica was exceedingly fine grained, so that whatever volume change took place in the silica grains themselves did not exert any decided action upon the piece as a whole.

One other point I wish to make is in reference to the rate of cooling. If we could be absolutely certain in cooling a piece that we were cooling all parts of that piece at exactly the same rate, we could, no doubt, cool very much more rapidly than we do now. In my opinion, a great deal of the trouble from firecracking is due to strains that are set up by unequal cooling of different parts of the same piece. In the cooling of an ordinary periodic kiln, certain drafts are set up through different portions of the kiln and it is certain that in many cases a part of one piece may lie in this draft or current whereas the remainder of the piece may lie in relatively still atmosphere. That portion of the piece lying in the draft would undoubtedly cool faster than the remainder of the piece and would set up a strain which might very easily cause the piece to crack. This would indicate that the method of cooling is of even more importance than the rate of cooling.

If some means could be devised for eliminating the difference in the rate of cooling in the different portions of the kiln, it would go a long way toward eliminating firecracking.

Mr. Sheffield:—I missed the point as to what effect more grog has on firecracking.

E. C. Hill:—Increase of grog reduces the tendency to firecrack. I might add that when all grog finer than 40 mesh was used, the tendency to firecrack was quite marked. When all grog coarser than 40 mesh was used, there was much less tendency to firecrack. However, the body with the grog coarser than 40 mesh did not seem to be appreciably better than the body containing both fine and coarse grog, so that it is hardly likely that the tendency to firecrack could be greatly reduced by taking out the fine grog.

Mr. Hottinger:—There is one point I would like to make here; that is the sand in the body itself.

It seems to me dependent on the character of the clay itself, that is, if we have a very dense burning clay and we add sand to it, we are going to have set up a great many more strains than if we had an open burning type of clay which is not so dense, such as is able to resist the strain of the individual expansions of the sand particles themselves. When we speak of sand in the body and what effect it would have, we always have to keep in view the character of the clay bond.

C. W. HILL:—In that connection, I think we should realize that this work is being done in a practical way. We could not do it in the most scientific way on account of the time, but it seems to me that we are putting all of these different bodies of clay through more or less the same temperature treatment, and are comparing results. If we could determine the most advantageous cooling rate for each one of these different bodies, we might have entirely different results.

MR. RADCLIFFE:—I do not know, but as an opinion, it seems to me that a clay and a grog should have very nearly the same absorption for the burning of terra cotta. In other words, if we are going to have a body with an absorption of 10%, our grog and clay both should be fairly low in free sand or silica, and they both should have about the same absorption. With a vitreous and a porous body, it seems to me that there is sure to be a difference in the expansion and contraction of those two materials, which will set up a strain.

It seems to me that a good experiment to make along that line would be as follows: Have some of these clays washed; calcine the clay in the regular kiln and then make a body, using 35 or 40% of this calcined clay and the raw clay; grinding the grog to various grades of fineness, and then putting them through a test by heating it up to a certain degree of temperature, and then plunging in water. I believe that would be a quick method of determining whether or not they have a tendency to cool and crack.

I would like to have an expression on that as a method of testing those materials.

A MEMBER:—We had occasion recently to make a harder body on a small job and we used one of our tight burning clays. On this particular order we got firecracking. That is a case where calcined clay was directly responsible for firecracking. We had been replacing sagger grog by a calcine of one of the clays used in the body.

A MEMBER:—Was it a sandy clay?

A MEMBER:—No.

A MEMBER:—What porosity or what absorption?

A MEMBER:—It was the tight burning clay; its absorption was one and one-half to two per cent; one of our tight burning clays.

Using the same mixture of clays, we got a lower absorption using porcelain grog than we did when using sagger grog. By substituting the calcined clay grog for the porcelain grog, with this same mixture of clays, we got about two per cent. We also got firecracking. This small order was burned in the regular kiln with other material made of the same clay but using sagger grog. The cracking apparently was not due to the clay. It was the small particles of the distinctly different material. That is the only cause I could see for firecracking in those particular pieces.

A MEMBER:—There is no question but that a dense body will cause cool cracking.

E. C. HILL:—The only way to determine the effect of the density or porosity on the tendency to firecrack would be to fire the same body through a range of temperatures. I did not do this because I did not wish to fire our kiln very much above cone 6. I considered adding various amounts of fluxes to the body and so get bodies of different porosities, but this would be determining the effect of the fluxes on the firecracking tendency, rather than the effect of porosity.

A MEMBER:—I differ with Mr. Hill on the use of Campbell's clay. We also have used a body made entirely of Campbell's clay and grogged on a small order and had no cracking.

E. C. HILL:—I would like to make one more point in this connection. Six years ago some experiments were made with various bodies made into rather large pieces. One of these bodies contained 65% of Campbell's red clay and 35% grog and was fired at cone 6. This body had an absorption of about 9% and there was no firecracking on the trials whereas there was considerable firecracking on the trials of the bodies with the more sandy clays with absorption as high as 17%.

MR. HOTTINGER:—In speaking of this Campbell clay, I believe it to be a clay containing a rather high amount of iron.

Now, possibly all terra cotta men who have had experience in years gone by, that is, in the time when we had a lot of red colored body, remember that some of those bodies were practically as hard as granite. I can recall very distinctly that in those days, we had very little trouble with firecracking.

DISCUSSION[1] ON "REFRACTORIES FOR OIL-BURNING FURNACES"[2]

1. **Fire Clays.**—(*a*) For the raw fire clay batter or dope used in laying fire brick. Required analyses of these clays from the principal beds now worked for commercial use. (*b*) For "target" oil firing to receive impinging oil flame and to maintain incandescent mass of refractory material, as flint clays; and so to utilize most fully the principles of surface combustion.

2. **Refractory Tile.**—Use of refractory tile or baffle, flat and segmental, to receive impact of oil flame and utilize maximum heat transfer, by radiation therefrom, and so to reduce to a minimum the heat transfer by convection from the oil flame.

3. **Fire Brick.**—The manufacture of high duty fire brick for oil fired furnaces. Required: typical examples of successful application of

[1] Refractories Division, St. Louis Meeting, Feb., 1922.

[2] See Grant, "Refractories for Oil-Fired Furnaces and Boilers," **4,** 390 (1921).

these fire brick under the extreme conditions of temperature, and the characteristic flame action of all burning equipment.

4. **Refractory (High Temperature) Cement.**—(*a*) For laying the fire brick, instead of raw clays batter. (*b*) For washing or coating of the finished surfaces to secure all joints against erosion and penetrative effects of flame action.

MR. GREAVES-WALKER:—This is a large order. Instead of taking up this question by sections, we shall discuss it as a whole. There is no doubt that the subject of refractories for oil-fired furnaces is a live one. There is probably more loss encountered in supplying refractories for this use than in anything else we run into. The use of fuel oil is growing. Extremely high temperatures can be obtained. Furnace temperatures around 3000 to 3100°F (the softening point of most No. 1 refractories) is easily and often obtained with oil as a fuel. Further, there is a physical reaction of some kind that destroys fire brick in an oil furnace.

An instance came to my notice a few days ago of an oil fired railroad tunnel kiln. I noticed the saggers were set so as to have a wide channel through the center of the car. These cars were not pushed continuously through the kiln but pushed down one car at a time. These openings came directly in front of the burners and the flame shot straight through between the saggers. I asked why this was found necessary and was told that in three or four trips through the kiln the saggers would be destroyed if the oil flame was allowed to impinge upon them, but by allowing the flame to shoot between the saggers they could get about 75 trips out of a sagger. Under the flame action the saggers rotted—they did not melt or crack but they became rotten and were of no further use.

That is the same difficulty they are having with refractories in the linings of oil-fired furnaces. The fire brick actually rot under the oil action. My theory of it is that the oil being shot into the furnace in a fine spray is impinged upon the brick and minute globules of oil vapor are exploding on the face of the brick constantly. It is a very small explosion but you have millions of them occurring every minute and it gradually destroys the surface of the brick. If it is a thin section it will destroy the whole section, or at least make it shaky. There is no noise attending except the roar of the oil going into the furnace, but there is an ignition that is instantaneous, taking place on the surface of the brick. Presumably, this action is what destroys the face of the brick or causes the difficulty that is encountered with brick in this service.

A number of people are using very hard and very dense carborundum bricks. It is claimed that they stand this action without difficulty. It seems, from these refractories having stood up, that if we could get a refractory brick that is as hard and as dense as a carborundum brick it would stand this particular action to which the brick is subjected and

which has been found so destructive. I have no doubt there are a number of men here who have run into difficulty in supplying brick for oil-fired furnaces. I think there is plenty of chance for discussion on this subject.

THE CHAIRMAN:—Dr. Endell, will you tell your experiences on the other side, with refractories in oil-burning furnaces?

DR. ENDELL:—We have no oil in Germany.

PROF. PARMELEE:—Are you using no oil furnaces?

DR. ENDELL:—We had a small open hearth furnace, five tons only, heated with oil. I remember the lining lasting for only five days. Oil is too expensive in Germany, hence we do not use oil there except on a small scale.

MR. GREAVES-WALKER:—There has been, since the war particularly, a very strong tendency to equip steamships for oil burning; in fact the United States Shipping Board is specifying oil-burning boilers and some of the coal burners have been changed to oil. Although using only number one refractories they have to keep continually relining their boilers. A ship making a trip from New York to San Francisco will have to reline its boilers at the end of each trip. Some of these boilers take 8,000 bricks for a single unit. In making a trip to the Mediterranean they will stop at Gibraltar and reline and possibly again at the Suez canal as they come back. This indicates to some extent what the problem is and what the expense is.

MR. HOWE:—There are several points which come up from time to time in connection with the use of fire brick in contact with oil that may be worth while to bring up at this time. For instance, where the American brick comes into competition with the foreign brick, such as the "Glenboig," it is noticed that the dense finely-ground Scotch brick seem to stand up very well as compared to the more open American brick. When American bricks were compared, the denser seemed favored decidedly.

We have this oil problem in the manufacture of gas. The bricks used there come in contact with the oil that is sprayed in and the bricks finally disintegrate. This disintegration could hardly be due to temperature changes alone. The amount of disintegration varies to a great extent, sometimes taking place after one or two hundred burns, sometimes running up into the thousands. Another condition that may figure in this is the formation of carbon monoxide and everybody who is familiar with the operation of these furnaces knows that with a temperature of 3000°F, the conditions are present for the formation of this carbon monoxide.

MR. GREAVES-WALKER:—One of the peculiarities I have noticed in connection with the use of carborundum brick; if you will examine a carborundum brick you will notice it has a peculiar skin and there are

instances that have come under my observation where carborundum brick would stand up without any signs of failure for a certain length of time, 6 or 8 weeks, or possibly longer, and then they would go to pieces almost all at once within a few days or a week after they started to disintegrate or after they passed a certain stage. I wondered whether the fact that the brick would stand up for a certain length of time and then fail was not due to that skin being ruptured and the brick then being unable to resist any longer whatever action to which it was subjected.

I also wondered whether it was not possible for a ceramic engineer to develop a skin for an oil-fired brick. If he could develop some sort of a coating or glaze on the surface of the fire brick making in effect a fairly dense high grade fire brick there is not the slightest question but that they would stand up better because they now do stand until this "skin" is destroyed.

Mr. Geiger:—Mr. Greaves-Walker, in telling of the sudden failures of carborundum brick and in mentioning the difficulties experienced in maintaining clay refractories in oil fired marine boilers, has brought up several points that are of great interest.

The sudden failures of carborundum brick have been due largely to improper initial firing of this refractory. Before the difficulties were understood and the failure encountered, insufficient attention was paid to the burning. The result was that the brick were soft in the center and had only a very thin skin of properly developed material. After much experiment it was learned that a very elaborate and costly burning practice was necessary to properly mature carborundum refractories. Since this has been put into operation these sudden failures have been overcome, for now the entire body of the refractory is hard and dense instead of merely the surface. Other improvements have been effected, and carborundum refractories produced in the past eight months are decidedly superior to those previously made.

In the introduction of a new refractory numerous failures are met. Of course there is no universal refractory, but to determine the limitations of a new product it is tried in many places where there is every reason to doubt the possibility of success. In many instances too, a new refractory is put into places where the tried refractories are very short lived with the hopes that, through some combination of circumstances, some economy may be effected in the long run.

Details of manufacture had to be learned through failures. Carborundum refractories have failed because of misapplication and because it did not develop at first that they could not be fabricated and burned just as clay refractories.

Mr. Greaves-Walker has spoken of the necessity of replacing fire-clay linings in steamship boilers practically at the end of every trip from coast

to coast. The labor costs in installing new linings and the losses attending the holding up of the vessesl are far greater than the actual costs of the refractories ordinarily employed.

The Luckenbach Steamship Company has purchased a great many carborundum brick for their oil-fired ships at an initial cost of ten or twelve times the price of clay brick. At this time the oldest of these linings has been through five, thirteen-thousand-mile trips without any repairs whatsoever. This means that the labor costs on relining furnaces for four trips has been saved and that the boats have not been tied up pending replacements to refractory settings.

Another installation for which we have more specific figures can be mentioned. At the plant of the Mitchel-Bissell Company, manufacturers of porcelains for the textile industry, oil-fired kilns are run to cone 16–17. Repair costs to combustion chambers lined with clay refractories amounted to $2,000 in eight months. Carborundum brick, costing $500 were installed and the kilns at present have been in operation over fourteen months with no combustion chamber repairs. Apparently, moreover, the brick are just as good as when they were installed.

With carborundum brick of the quality now being manufactured, we have not had a single report of failure in oil-burning furnaces of any kind.

MR. LAIRD:—I would like to know how important the question of salt in oil is. I have known of several instances of the failure of refractories under oil firing apparently due to some material coming from the oil.

PROF. PARMELEE:—I understand this trouble is peculiar to certain oils, especially those of the Pacific Coast, if I am correctly informed.

MR. GREAVES-WALKER:—You have heard of the success of the carborundum brick in solving this problem of oil-burning furnaces, but I do not think that the fire clay brick manufacturer need be discouraged. The fact of the matter is, he has something to aim for. There is such a large difference between the price of clay brick and carborundum brick (and probably always will be) that the field is certainly worth getting into. I think it is one that will bear some study and some thought on the part of the fire clay brick manufacturer. Experience has shown that there are very few ground fire clay mixtures sold for laying up fire brick that are suitable for use in oil-burning furnaces. This is probably due to the fact that the ground fire clay almost invariably has a lower fusion point than the brick it is to lay up. Consequently, the mortar joints are the first to be attacked by the high temperatures encountered and this in turn subjects the weakest part of the brick (the edges and corners) to attack.

The original question suggested for discussion asked that analyses of clays suitable for this purpose be given. This information would not be of great value, but it can be said that for the average oil-burning furnace, fire clay mortars fusing below cone 32–33 should not be used.

For "target" oil firing, walls or baffles built of brick or tile have not proven successful. Recent experiments have shown that "targets" built of calcined diaspore in lump form analyzing 85% Al_2O_3 or above, will solve the problem. These "targets" are built in the same manner as a rustic boulder fire place, the mortar joints being of the same material as the lumps. High grade flint fire clays have been used for this purpose, but have a tendency to disintegrate or break down.

Refractory tile or shapes when used to receive the impact of the oil flame have not proven generally successful due to the fact that severe disintegration takes place and where there are wide variations of temperature, the shapes crack.

Very few, if any, of the brands of high heat duty fire brick have consistently stood up in this practice. Results have shown that the conditions require a super-refractory. So far two brands of super-refractories have proved very generally successful. These are put out under the trade names of "Arcofrax" and "Carbofrax," the former being a high alumina refractory and the latter a carborundum refractory.

The market has recently been over-run with so-called high temperature cements. Many of these have no merit whatever as refractories on account of their comparatively low fusion point. Some of them are simply ground ganister with an addition of sodium silicate and others are nothing more than a mixture of ground fire-brick bats and clay.

Asbestos, talc, and many other like materials, to which a bonding agent has been added, are also used. About the only thing that can be said in their favor is that they have a cold set, *i. e.*, they will set up before heat is applied and this property is always obtained at the expense of refractories.

High alumina cements such as arcofrax (pulverized), the carborundum cements when not diluted with too much fire clay, and ground chrome ore, have all proved very effective when used in laying up brick work in oil-burning furnaces. On account of the variation in thickness which is experienced in even the best brands of refractories, a better job can generally be done with the super-refractory cements if the brick are all laid with a trowel instead of dipped. With a trowel a perfect but thin joint can be made that takes up any inequalities on the edges of the brick and thus prevents the oil flame from getting a start in the thin opening generally left when brick are laid up by the dipping method.

There is no question but that considerable protection is given the brick work by a coating of a high grade super-refractory cement, although unless new coatings are applied the protection is only temporary as the original coating is soon disintegrated and disappears.

DISCUSSION[1] ON "A MODIFICATION OF THE MOLECULAR FORMULA FOR GLAZE AND ENAMEL CALCULATIONS"[2]

Mr. Staley:—It seems to be taken for granted that I am entirely opposed to the use of molecular formulas in compounding enamels. Personally, I have never been able to use the molecular formula with any success, and for a good many years I have used calculated melted weights instead of the molecular formula. If others can use these formulas I am willing to concede they can do something that I can not.

Mr. Danielson:—It seems to me that the only materials Mr. Hansen has definitely placed are the fluorides. I can give him a formula similar to his example by using a combination of feldspars for which it would be impossible to figure the batch even from this molecular formula. Some of the potash, for instance, may go in as nitrate or as feldspar, hence, it is impossible to figure definitely just how much of the various constituents, potash, soda, etc., is derived from the various batch materials unless the exact chemical analysis of each is known.

Mr. Hansen:—When expressing a formula in terms of materials used so that it can be duplicated by another worker, we should know the composition of such materials as feldspar. It is not sufficient to state that "four hundred pounds of feldspar was used in this enamel" and expect that any feldspar will produce the same results. We do not have pure feldspars. To duplicate results with different feldspars on any sort of formula scheme of expression, the composition of feldspar must be known. I admit that this formula does not establish the identity of all the constituents.

You have to use a certain amount of reasoning in the interpretation of a chemical analysis, and it is no better than the way you interpret it. The scheme here proposed reduces to the minimum the uncertainty in the reasoning employed. The old formula admits of greater misinterpretation of the fluorides and this modification certainly does establish the identity of the fluorides and seems to me to present certain advantages which are worthy of being taken into consideration.

Mr. Landrum:—We will all agree that graphic methods for the representation of facts are highly desirable. The writer of this paper has gone one step farther in giving us more data in a graphic form than is given by the old Seger molecular formula. However, it seems that he may have lost something of simplicity in so doing, for instance, in the fact that we can not tell what feldspar he used.

What is the advantage of this graphic formula over actually giving the batch mixture to start with? I think that no paper should be given, for no paper is otherwise of any use whatever, that does not give the batch

[1] Enamels Division, Feb. 28, 1922.

[2] J. E. Hansen, *Jour. Amer. Ceram. Soc.*, **5**, 338 (1922).

mixture. I would take for granted that, if the author's purpose is to give information, the batch mixture would be given.

Comparison of batch mixtures is an impossibility unless they be on a unit basis. I have had fellows ask, "What do you think of this formula?" No one can tell anything by looking at the batch mixture. Why not go one step farther and calculate the melted weights, taking into consideration the gases that go up the chimney. This is Mr. Staley's method of melted weights. A man can, by looking at two formulas, in terms of melted weights, make intelligent comparisons.

You have, even with Staley's method, so many factors to take into consideration, especially with nineteen or twenty ingredients, that no quick conclusion can be drawn.

Each one of the materials that goes into the batch mixture adds certain things to our final analysis. It adds those things that we all find in the chemical analysis. The research worker who is trying to duplicate an enamel, with only the finished piece of ware as a sample has a very difficult proposition. Anyone who has tried to do this, even with analyses that were correct, knows that he has just this same sort of synthetic problem that you have with ordinary molecular formulas. In other words, the Seger molecular formulas are those from which the analysis of your formula is made. To work backward from either you will have to use a great deal of ingenuity and much resourcefulness, and, before you have any success at all, a lot of experience in the actual making up of many batches of enamel.

I think that this method of representing the batch mixture, giving the fluorides in place of oxides, is a good one. The old molecular formula had all the soda grouped, no matter where it came from, as well as all the calcium oxides, etc., and certain comparisons could be made directly and quickly.

If you are going to get away from the simplicity of the molecular formula, I would just as soon get away from it altogether. I do not believe in taking percentage compositions of the actual materials put into the batch. What I mean is to carry that one step further and take the molecular weight and divide it into pounds, thus obtaining a factor which represents the number of molecules.

I do not see any advantage in stopping where you have. Why not, in that same form, put all the factors in one column and have them in the molecular proportion, that is, the equivalent proportions. I do not see what advantage you have gained by putting calcium fluoride in the column with the RO_5 and not putting sodium oxide there when part of it comes with B_2O_3. It really does not tell you all any more than the molecular formula, and it does lack the simplicity of the molecular. Fluorine generally has been given with the acids simply to show how much of the

soda is present as cryolite, how much of the lime as fluorspar and how much carbonate.

We do not say this molecular formula represents the final analysis of the enamel. It is simply the representation of certain facts, and we might each one use it for our own problems and publish it in our own way. I think in general we should adopt some method to present these facts. I think the old molecular formula combined with the old batch mixture tells a whole lot.

We have to go one step further to Staley's method. The ultimate composition of an enamel can be interpreted in a dozen different ways, using in one case cryolite to furnish the alumina and in another, feldspar, and still another, the oxide; and each will give a radically different result. Cryolite acts as cryolite, not as sodium oxide and fluorine. Nor does cryolite act as aluminum fluoride and sodium fluoride. I still maintain that in our papers we must give the results in terms of batch mixture as well as molecular formula.

Mr. Hansen:—Mr. Landrum brought up several points that came through my mind when I was working this out. I will admit the old method of the molecular formula used in most papers on enamels and glazes has the utmost simplicity, but in order to interpret it correctly, we have to have the original batch formula. Mr. Staley brought that out some three or four years ago in the *Transactions*. In other words, we have to keep two tables in mind when interpreting the formula. We can go to the other extreme and express our formula in terms of equivalents of each of the constituents, so many equivalents of fluorspar, so many of soda ash, sodium nitrate, etc. It seems to me, though, that such a formula would be too complex. We have to draw the line somewhere. Cryolite acts as cryolite, not as sodium oxide, aluminum oxide, and a certain amount of fluorine. This is shown by this proposed form of expression. I had to draw the line between the utmost simplicity and a certain amount of complexity.

DISCUSSION[1] ON "THE GREEN STAINING OF CLAYWARE"[2]

Mr. Hottinger:—On this subject, I am sure we all have had some experience and probably some contradictory experiences.

Mr. Albery:—There is one thing that we have probably missed in Seger and that is the article on green discoloration of light-colored bricks, and if you will look on page 359, Vol. I of the Collected Writings of Seger, you will find he referred to an organic growth that occurs on light-colored bricks in a moist and humid atmosphere; a growth of algae. When I was working for Mr. Gates, we had some experiments made to test this out.

[1] Terra Cotta Division, St. Louis Meeting, Feb. 28, 1922.

[2] Hill, *Jour. Amer. Ceram. Soc.* (*Bull.*), **5**, 51 (1922).

Seger recommends an insecticide as a preventive but not as a cure for the same. The insecticide naturally prevents this organic growth. We used a zinc sulphate solution, and were able to prevent the green discoloration from developing.

MR. C. W. HILL:—The organic stain mentioned by Mr. Albery is of course a different matter from stains or suspensions. The organic growth may be differentiated from the other by inspection or by microscopic examination and may be burned whereas the inorganic green stain on ignition gives a black residue. There need be no confusion as to the two kinds of stains.

MR. HOTTINGER:—I should like to ask Mr. Hill whether he tested for vanadium?

MR. C. W. HILL:—We did not test for vanadium. Since we obtained such a copious test for iron and silica (possibly alumina too) which would indicate that the material was almost entirely an iron compound, it seemed needless to bother with any small quantities of other substances. The large amount of iron was enough to explain the coloration.

As stated in the paper, as Seger's analysis showed no iron there may be green stains due to vanadium and not to iron. Our contention is merely that the stains which we have examined are due to iron compounds. Because of failure to get an iron test easily, it is probable that some stains have been attributed to vanadium that were iron stains. Certainly before blaming it on vanadium, one should make certain that the stain is not due to iron compounds.

MR. ALBERY:—The one sure preventative for the appearance of green discoloration, organic or inorganic, is the use of impervious slips.

DISCUSSION[1] ON "A NEW TYPE OF GAS-FIRED VITREOUS ENAMELING FURNACE"[2]

BY A. STOCKSTROM:—After three months of operation we have no fault to find with our gas-enameling furnace; in fact, the results have been more than satisfactory. The quality of our ware has improved, our cost of production has decreased and the service from the enameling department to the assembling departments has greatly improved.

Having previously used only coal fired muffle furnaces, with which temperature control is very difficult, we attribute the improvement in quality not only to the fact that the enamel is fused at a decreasing temperature, but also to the accurate burning temperature obtainable. The flexibility of control also makes it possible to quickly change the kind of ware being burned or the kind of enamel, which is a great help in a plant

[1] Recd. August 1, 1922.

[2] H. H. Clark, *Jour. Amer. Ceram. Soc.*, 5, 478 (1922).

where many different parts are needed daily in order to keep the assembling departments supplied.

However, our main object in trying a furnace of this kind was to get away from furnace breakdowns and the consequent expense and interruption of production. Our furnace has now been in use approximately 2,160 hours and the brick work is apparently in the same condition as when put in. During this time it has been entirely shut off every week from Saturday noon until Monday morning.

On Monday mornings it takes about 40 minutes to bring the furnace to working temperature.

We use artificial gas of 580 B.t.u. per cu. ft. quality and our consumption from April 14th to May 15th was 835,000 cu. ft. or total cost for gas $710 during which time the furnace was in operation 510 hours, which shows an average hourly gas consumption of 1640 cu. ft. per hour or an hourly gas cost of $1.40 with gas at $.85 per 1000 cu. ft. During this time we turned out 137,700 sq. ft. of ware with this furnace or 270 sq. ft. per hour, which gives us a fuel cost of $.52 per 100 sq. ft. The ware consists of flat sheet iron parts ranging from 24 to 18 gauge.

We are not able to determine at this time the exact saving as compared to coal furnaces as we do not know what the life of the gas furnace will be, but from all indications the furnace will need no repairs for some time—in fact, it should last almost indefinitely.

American Stove Co.
St. Louis, Mo.

DISCUSSION[1] ON "PHYSICAL DEFECTS IN TANK BLOCKS"[2]

Mr. Loomis:—This investigation was made for the Corning Glass Works. We examined the structure of a number of tank blocks to determine the number of fissures. We chose several makes which we had in stock and took blocks from carload shipments. These blocks were cut into sections about 3 inches thick, and note was taken of the number of fissures and other defects present. There was only one make of block examined which proved to be totally free of fissures or defects.

I believe it is generally conceded that fissures are detrimental to the life of the block, and therefore to the life of the tank, since the glass penetrates the fissures, especially if they are of any size. In all cases but one, we found fissures varying from $^1/_4$ to 3 inches in length and quite a number of holes $^1/_4$ inch in diameter. Some of the blocks were very badly laminated; but in one case there were no defects of any sort in the three blocks chosen. The blocks examined were taken at random from the shipments. It looked as though one maker, at least, had found a method

[1] St. Louis Meeting, Feb., 1922.

[2] Loomis, *Jour. Amer. Ceram. Soc.*, **5**, 102 (1922).

of making perfect blocks, or was using closer supervision. This paper was presented with a view of pointing out the possibility for improvement and was written from the standpoint of the glass manufacturer rather than the block maker.

Mr. Zopfi:—I would like to ask Mr. Loomis if the block that showed no defects gave a longer service than the blocks that showed defects.

Mr. Loomis:—In this particular case, they did not, but other things being equal, the better-made block, it is to be expected, would give better service. I do not believe any body will disagree on that.

Mr. Zopfi:—I grant you that, Mr. Loomis. We had occasion within the last six months to examine some blocks that were perfect in mechanical structure and denseness but they did not compare in service with blocks that we knew to be defective, that is, which had laminations and fissures.

Mr. Brown:—Several years ago I saw a bottle tank that lasted less than four months. The reason was sought. Examination showed many places where glass had penetrated nearly through the blocks. The blocks not only had spalled unduly but large pieces had cracked off where the glass had eaten back into the fissures. Many voids existed in the blocks and at some of these holes finger prints were easily seen on the clay. In making the blocks not sufficient care had been used in bonding the different layers. This instance was an extreme case of fissures in blocks.

Mr. Loomis:—There is more of a chance of the blocks being rapidly attacked if made with fissures or laminations than without them. You can more readily predict how long tanks with well-made blocks will last than when one or two of the blocks are poorly made. Poorly-made blocks will let the glass eat through, which means either making a hot repair; or the tank being put out.

Mr. Fisse:—I find that a great many of the manufacturers want extremely large blocks. I believe it to be the consensus of opinion of the men making blocks and also some of those who use them, that a smaller block will give the best results.

For the making of a block that weighs in the neighborhood of twelve hundred pounds the average glass manufacturer will allow about four months. How is the manufacturer going to know whether that block is thoroughly dry on the inside? He can not tell. When a block with a wet core is burned, steam will be developed causing a fissure. The wet clay portion will part from that which is dry.

During the war we had some bad coal. Suddenly we obtained some good coal. The firemen did not know the difference, hence they shoveled in the same amount of this good coal as they had of the poor grade. In consequence the heat increased too rapidly and cracked the blocks. Those blocks were shipped and the customers made complaint about cracks.

After about a year they asked, "Can you not send us some more cracked blocks?" They had gotten very satisfactory service out of them.

Mr. Grafton:—The answer to that is with the good grade of coal they burned the blocks all the way through. They got a splendid burn in the blocks, perhaps a better burn than usual.

I never made tank blocks with pug mills. That is the only way I have not made them.

The blocks Mr. Brown refers to must have been some I once heard of where the manufacturer placed wire in the blocks when they were made and then pulled the wires out to provide air spaces so the blocks would dry quickly.

Of all the blocks I have seen, I find the blocks are made best by making them by hand; that is, laying them in the same manner you would lay the bottom of the pot, starting with a layer about 1 inch thick and then laying each layer at right angles with the previous layer. After the block is built up the spare clay on the sides and ends is cut off with wires; drying and burning in the usual way.

I do not agree with Mr. Fisse that blocks are going to show a defect when they are burned on account of being large blocks. That is simply a question of proper burning and proper drying. I agree that you can not hasten the drying. The drying of twelve hundred pound blocks is entirely different from the drying of those weighing only 230 pounds.

Nearly all blocks will show some defects, small holes, drying cracks, etc., but I always felt safer in cutting blocks that had been laid by hand because we never found any defects to any great extent in such blocks.

You may wonder why we do not manufacture in this fashion. The answer simply is we can not afford to do so, and the glass man does not wish to pay more than the generally accepted market price for his blocks. In laying them by hand you have to use softer clay, hence they take longer to dry and you have to have five or six dollar a day men to do it, and not the old time two or three dollar men. It is simply on account of the expense that we do not make blocks by hand. I think, however, that better blocks would be made that way.

Mr. Zopfi:—I want to support Mr. Fisse in his argument that a large block can not be made successfully or burned successfully with the same material in comparison with a smaller block. You can make a smaller block much better, and you can burn that block to a high temperature more uniformly through it than you can a large block. The higher temperature you burn a block, the more serviceable it will prove in the furnace.

Mr. Fisse:—I wish to correct Mr. Grafton's interpretation of my statement. A large block can be made without fissures. I know this to be true. The making of it, however, requires a much longer time. No

man should expect to make a block eighteen by thirty-six by forty-two in four months, because it can not be properly done.

MR. AURIEN:—Mr. Fisse is in the Clay Department of the Mississippi Glass Co., hence has an opportunity that other fire clay manufacturers do not have. When he wishes to make an experiment, they do it at the glass works. We are the goats. They have made a great number of large blocks which we have used in our 600-ton tank, with good results. These successes with large blocks are due, I believe, to the fact they have given time to thoroughly dry and burn them. If large blocks are given plenty of time to dry and burn, they will be good. The smaller block is easier to make however, and, as a rule, gives more economical results.

MR. DIXON:—I am a builder, hence use blocks in the building of furnaces. It has always been my opinion that any lamination or crack or joint in a block is a defect. It is just the same as having too many horizontal joints in your tank wall. The alkali fumes will penetrate them and attack the block. That has always been my conception even when in the block business myself.

In contradiction to that, here is an odd thing. In the eighties, when they were just starting to build tanks in this country, Belgian engineers came here and built three window glass tanks. They shipped the blocks from Belgium. I never saw such a mass of clay in my life. They were as irregular as rough stones. They had stone masons chiseling those blocks into the sizes they wanted and there was not a single surface that was not full of holes, crevices and fissures.

These blocks came from where they had developed tank furnaces, and had used them for years. Afterwards, I went to the plants where they made these blocks. No one here would ever think of making a block like they made and still are making. They use moulds without bottom, just the frame. This they set on a board, and put a prop between the ceiling and the mould. They make the clay in a pit just as we do here. They roll a lump of the clay on a table by hand and then chuck it into the mold. They fill one corner and then the other corners one after another. The clay is just absolutely gobbed in. In this careless manner they fill the mold. They then find the clay has pushed out under the mould frame and has raised the frame at least an inch in spite of the prop or brace. They let the block stand for a couple of days until it stiffens, and then trim it with a long knife to make it nearly square and of proper dimensions. Yet their blocks seem to stand just as long as ours, and their furnaces give just as good service as ours.

We go to a lot of trouble in making blocks, that do not stand one day longer than theirs. Now, why is this?

This is a field worthy of investigation. Is it not natural to suppose with all the pains we take to make blocks, they should give better service?

I read the article by Mr. Loomis and I agree absolutely with what he said. I can not believe that a block full of cracks and lamination crevices can stand up as well as one that is put together in a good homogeneous, careful manner. And yet, why we do not get the service out of the better made blocks?

MR. HAUSER:—I would like to ask Mr. Loomis if he thinks a tank block can be too dense.

MR. LOOMIS:—Naturally a block can be too dense. If it is too dense it will crack when being heated up in the tank. If somebody gets an idea they can get a tank ready for production overnight, or in one or two days, the blocks are very apt to suffer, and in that case too dense a block is a very serious thing.

MR. WRIGHT:—Mr. Dixon made a statement which was somewhat surprising to me. Dr. Turner, after touring this country wrote a summary of his trip and I believe he stated that the American manufacturer was obtaining longer service from glass tanks than the English manufacturer. There seems to be a difference of opinion.

A MEMBER:—I believe Dr. Turner pointed out that almost universally in this country, perhaps window glass excepted, we use soda ash which is less corrosive than salt cake as used extensively in England.

MR. DIXON:—The three tanks mentioned actually did give a very long service. Of course, at that time the window glass manufacturers in this country used salt cake entirely. Through information received from other sources I have learned that we do not get any longer service from our tanks than they do over there, but we must remember that in England there is only one factory of any consequence making window glass. It is only recently they have copied American installation. Previous to the war they bought most of their plate glass and window glass from Belgium or in Germany; most of it in Germany.

I wish to mention one other thing in regard to blocks and the life of blocks. You will hear it said that if a bottle or jar manufacturer gets twelve months out of his tank he is mighty well satisfied. The decolorizer they are now using is worse in its effect on the blocks twice over than manganese. I can not tell you why, but it is true.

MR. AURIEN:—Mr. Dixon's discussion is vitally interesting to me. It is just recently that we began the use of selenium and cobalt decolorizer. When in place of eight pounds of manganese in a thousand-pound batch we use one ounce of selenium and cobalt decolorizer, one would hardly expect that it would affect the block.

I wish to refer again to longer life obtained from small blocks. We used to, on many occasions, run twelve, thirteen or fourteen months without a hot repair, and again we would run 10 or 11 months or stretch our run to 16 months, which we thought was a fairly good run. Now, we go twenty

and have gone as long as twenty-two months and a half without a hot repair. I can not tell the reason for this longer run now in comparison with former times, but I think it is because we build the tanks with straight-line joints and have broken the joints properly, and have used smaller blocks.

We make figured glass and wire glass. We fill 150 to 180 tons of material in 24 hours per 600-ton tank, not for one day or six days, but twelve, sixteen, eighteen and twenty months. We believe this larger capacity and longer service is due to straight, even joints and not using too big a block.

MR. HOSTETTER:—You use floaters?

MR. AURIEN:—We just use one set of floaters.

MR. HOSTETTER:—No bridge wall?

MR. AURIEN:—None.

MR. YUNG:—I would like to know what you mean by the life of a tank. Lots of people think the life of a tank means the time from the start of fire until the fire goes out; other people think it is from the time you have the glass melting until you make your hot repairs. In comparing the life of tanks, it seems to me mighty important to understand in what units you are talking.

I would like to substantiate some things said by Mr. Loomis. The largest burden of proving the value of sound blocks ought to be up to the block manufacturer rather than the glass manufacturer.

For quite a few years now, I have taken a photograph of the tank on the inside every time one goes out. This sort of a record has shown some very peculiar things. With blocks from the same shipment and supposedly of the same batch, you may have one block flux down to $^1/_2$ inch, while the others stand up to 6 or 8 inches. This, it looks to me, is a question of workmanship. I have seen other blocks standing in which holes and cracks would develop into which you could put your hand for 6 or 8 inches. Such irregular service, it seems to me is up to the block manufacturer to overcome, for if they were making uniform blocks the blocks would naturally wear uniformly.

MR. AURIEN:—We consider a run from the time we make our first cast. Probably the life of a run is due somewhat to the time taken to heat up the furnace. Suppose they direct me to start Number 4 furnace on the first of March. I will tell them that on April first we will make our first cast, and not before. We might shade that time a day or two, but roughly it is one month from the time we start a furnace to the day we make the first cast.

I have heard of instances where they will put fire to a furnace and in ten days after that make a cast. This I think is absolutely all wrong. You are doing an injustice to a tank block. There is no doubt about that. We take thirty days to heat the furnace to the casting condition because

we think it adds to the life of the furnace. If we get twenty-one months out of our blocks why can not those who use the same blocks?

MR. HOSTETTER:—Do you start with a full cullet melt?

MR. AURIEN:—Absolutely, we start off with a full cullet melt, and about 4 or 5 days before we are ready to cast we start to fill the batch.

MR. HOSTETTER:—A green tank?

MR. AURIEN:—Yes.

MR. DIXON:—Mr. Chairman, that very thing is the secret of his success. Naturally he fills every joint, lamination and everything else with molten glass so that all of the joints are sealed and glazed.

I am convinced there is no use making the blocks very thick. The walls of the first ones built in this country were 39 inches thick; think of it! Inside of a week or two eighteen, nineteen or twenty inches would slough off into the glass.

A concern using 8-inch blocks in a flint glass tank began to have trouble in about 8 months. Glass was coming through the joints. They complained that the tank did not run as long as it should. By inquiry in the factory I found that in nine days from the time that tank of 250 tons capacity was repaired with those eight-inch blocks, they had poured glass. Nine days after they lit the fire! I said, "Gentlemen, you need not tell me anything more." Think of it: They were pouring glass in nine days and then had the nerve to kick about the blocks.

MR. FISSE:—We shipped a concern almost a complete tank. We also shipped blocks to one of their nearby neighbors, also in the window glass industry. The blocks to both concerns were probably made out of the same batch of clay. The first one got about eight weeks out of his blocks (eighteen-inch wall) the other one got in the neighborhood of sixteen weeks. When those blocks that lasted only eight weeks were taken out, an arm could have been shoved into the fissures. The blocks were thoroughly permeated with glass.

Now, the whole proposition is this: they were not burning off the salt and water from their batch, but allowing them to saturate the blocks because the end of the fire was playing into the checkers. The other concern had the end of the fire in the combustion chamber and was burning off the salt water. It is the salt water that does more damage than anything else. You have to get rid of it.

MR. BROWN:—Mr. Aurien has stated he has run a 600-ton tank making wire glass, for over twenty-two months without any kind of repairs; I would like to ask if water coolers were used on the furnace.

MR. AURIEN:—I will say this, with absolute frankness, that the last twenty-two months run which we had on our big No. 4 tank, there was not as much as a brick or a handful of clay added to that furnace. After the first eleven or twelve months' run, we applied air in all spots that

showed a little bit red, and we maintained that air there until the furnace was out. Did I answer your question?

MR. BROWN:—Yes, that is very interesting. I think Mr. Dixon may be able to tell us if, when you put water on a tank to cool your blocks, your salt water is liable to run over to that cold side of your furnace and thus get one thing fighting against the other.

MR. AURIEN:—I may answer just that portion of your question. We have very little to contend with regarding salt water. Our batch is a 1000 pounds of sand, 370 pounds of limestone, 320 pounds soda ash, 58% dense and only five pounds—just imagine—only five pounds of salt cake. At times we would not necessarily need the salt cake; that is, not every day. About Thursday, Friday and Saturday of each week we add salt cake to get rid of our crust. You can imagine that our salt water is nothing.

There are very few manufacturers who would dare to wash out their checkers with 75-pound pressure water through a two and a half inch fire hose. We do not do this until after a five months' run. This is to allow sufficient time for the checker brick to become dense, *i. e.*, lose their porosity. If they are new and open and you apply the water onto new pores you would choke them all up, but after they are well burned—say after five or six months—they will then wash clean. We do this on Sunday morning and it only takes about thirty minutes to do it. We go through every checker once and then in a half hour we wash them again. Some of you are laughing, but it is a fact.

A MEMBER:—That is true.

MR. AURIEN:—We credit the longevity of our furnace to that one condition.

A MEMBER:—Did you ever take steam?

MR. AURUEN:—I believe you could use steam. Your checkers are hot, hence water answers the same purpose.

MR. DIXON:—That is not really new. I saw that done over thirty years ago. You can only do that though, if the accumulation is in the form of dust.

I know a man who actually built a tank of wood and melted glass. I know that to be an absolute fact.

MR. AURIEN:—I beg your pardon, gentlemen, but Mr. Dixon has gone me one better.

MR. DIXON:—He built double walls of planks, and between them he had water flowing, a water-cooling proposition that was unique. He actually melted glass in it. But here is where he fell down. He neglected to protect the plank at the glass level. If he had put an overhanging block on the wall above the plank wall to protect it, he would have gone on melting

glass. That was done in New Jersey. Then you talk about laminations in tank blocks.

MR. BROWN:—It has been my understanding that about the same batch is used for wire glass as is used for window glass. Since Mr. Aurien's batch contains practically no salt cake it would be expected to have less corrosive action on tank blocks than does a window glass batch containing considerable salt cake.

MR. DIXON:—Do you not know that window glass people use salt cake because it gives a lustre and brilliancy that you can not get from soda?

MR. BROWN:—Here is a man getting along without it.

MR. DIXON:—Of course, there are lots of them doing without it, but he is making wire glass. He is not making the glass you are making. They use the salt cake because it gives window glass a brilliancy and lustre that they do not get from soda. Soda ash glass in a window will finally get dim and will not retain the lustre and brilliancy as will the salt cake glass.

DISCUSSION[1] ON "THE HANDLING, STORING AND SETTING OF GLASS POTS"[2]

MR. DIXON:—Mr. Forsyth failed to touch on one important feature from a furnace builder's standpoint, and that is the care of the bench of a furnace. We have had any number of cases where furnaces have lasted without repairs from five to six years; in one case seven years. We have had other cases where they have gone out in one or two years and they wonder why they fail to get the same service. The answer is that every time they set a pot they do not fill the gulleys that they find on the bench of their furnace. Those gulleys should be filled so that the glass will not continue flowing through that same channel and eventually eat its way to the bottom part of the furnace. Those who take the precaution every time they set a pot to keep their bench in repair are the ones that get long life and service from their furnace, and that is a mighty important feature, for the rebuilding of a furnace is a very expensive proposition.

There is another matter in setting pots; every pot has a concave bottom. No matter how carefully you spread sand on the bench with a rake or any other kind of tool, it is impossible to get an even bearing on the bottom of the pot, which has to carry the entire weight of the glass, unless the pot is worked back and forth two or three times until it absolutely beds itself in the sand underneath. This gives the center of the bottom the same support as it has around the outside and prevents the bottom from dropping out.

There are some very funny things that happen in the handling of pots.

[1] Discussed St. Louis Meeting, Feb. 28, 1922.

[2] Forsyth and Clark, *Jour. Am. Ceram. Soc.*, **5**, 146–50 (1922).

As I remember, years ago when we were in the pot business, we had a complaint from customers to whom we had shipped carload after carload of pots. They complained that they all either broke in the bottom or cracked around the wall at the bottom. It became so serious that we went there with a carload of pots to observe how they handled them.

They had a pot carriage and they carried them from the car, and everything of that sort. Their pot carriage had a small swivel wheel in the center that enabled them to turn around almost within the circumference of the pot, which was very convenient, but to do this turning they took two pieces of about one and one-half inch hemp rope and laid them crosswise over the carriage which, when the pot rested on them, gave them four points to pull on. Now where those ropes crossed right underneath the pot there was a hump that sustained the entire weight of the pot and when they pulled the pot over to the place where it was to be stored the whole pot was riding right on the center of the bottom which is the weakest part of the pot. That was the trouble and the problem was solved and they only found it out after they had ruined three of four carloads of pots.

Mr. Forsyth:—I would like to ask Mr. Dixon if the channels he means are those from the back of the pot down to the slag holes?

Mr. Dixon:—Yes.

Mr. Forsyth:—That, I will admit is not touched upon at all in our paper, but the matter of getting an even cushion under the pot was implied by the word "settled" but not discussed in detail.

A Member:—I would like to ask Mr. Forsyth, if he ever had any experience in raising the pot off of the bench, that is, elevating the pot?

We had one glass manufacturer send us specifications to make a pot with channels on the bottom, if I remember correctly, about four stilts or three stilts on either side, radiating from the center and about ten inches high. When the pot was set in the furnace this would allow a passage of heat underneath the pot. I presume the object was good melting.

It has always been customary to set pots on the bench of the furnace. The Sneath Glass Co., of Hartford City, Ind., had a fire clay bench in a furnace that I know was in operation for 16 years. They were very careful when they removed a pot to fill up all the crevices, as Mr. Dixon would put it, and it looked foolish the amount of time they would take in leveling off that bench. The bench was always carefully prepared for the pot and I noticed that they always scraped out the middle of the sand before the pot was set back and then it was shifted around as Mr. Dixon described in order to settle it.

Now we all know that with existing conditions the fire can not get at the bottom of the pot. The general practice throughout the country is that the temperature of the pot arch is not brought up to the temperature of the furnace. In many cases it is as low as 200 °F, below the temperature

of the furnace. Therefore, the pot will not be burned as hard in the pot arch as it will be in the furnace and if it is set with the bottom on the bench it is certain the bottom will not be burned as hard as the rest of the pot. I remember our customer showed me the pots that he was using and I remarked that he would surely have to set them on the bench and he replied, "No. It may not be done elsewhere but we are elevating them and getting successful results."

Mr. Forsyth:—I will have to confess that practically all of my experience with pots has been at one plant, and I believe I can safely say we have an exceptional man in charge there. It is a hobby with him to take care of his furnace. We have one furnace that only needs a fire in it to start it up after seven years of operation. I think Mr. Dixon is familiar with the furnace.

We have tried putting the pots into the furnace on jack bricks and then taking down the breast wall and letting them down again. Our experience has been with all such tests that an assertion on a few tests is unreliable. We prefer to make a statement only after a considerable quantity have been so tested. As we only tested a few pots in this particular manner the results were not considered conclusive. As I remember, we attained good results but nothing extraordinary.

DISCUSSION[1] ON "OPERATION OF LEERS[2]

Mr. Payne:—Mr. Adams objected to the phrase that Mr. Frazier used when he spoke about "the temperature at which the strain is introduced," and claims that there is no strain in the glass until it is at a low temperature. At our factory we use a pressure of five thousand pounds per square inch in the making of tumblers. With this pressed ware we have much more trouble in getting satisfactory annealing than with articles of the same size and weight made with low pressure. On the Owens machine, a pressure of about 18 lbs. per sq. inch, the annealing is much easier than with tumblers. We feel very sure that strain is introduced when the plastic glass is compressed at a temperature above the annealing region. That is, we think strain is present before the temperature of the glass has been lowered to 1000–900°F. As I understand Mr. Adams, it is his belief that there is no strain until these temperatures are reached.

Mr. Hostetter:—You have a higher initial strain, in other words, than you do in using lower pressure.

Mr. Payne:—That is our opinion. We press from five to eight thousand pounds per square inch.

[1] Frazier, *Jour. Amer. Ceram. Soc.*, **5**, 37–42 (1922). Adams, *Ibid.*

[2] St. Louis Meeting, Feb. 28, 1922.

MR. HOSTETTER:—May I ask what the difference in thickness of the ware is?

MR. PAYNE:—About the same in either case. That is, all the way from a half inch at the bottom to an eighth inch in the tumblers, and in some of the bottles we make, it would be almost that thick in the bottom.

MR. DIXON:—Isn't it true, you get a strain in the initial process of pressing the glass from the mere contact of the iron?

MR. PAYNE:—It was our opinion we were getting some due to the enormous pressure.

MR. DIXON:—Leave out the pressure—the mere contact of the iron I mean.

MR. PAYNE:—That is probably so. That is often shown by minute cracks that are visible.

MR. HOSTETTER:—It is the consensus of opinion, varying in particulars of course, that there is a difference between what we call chilling action and the strain introduced mechanically in the blowing. The subject is one that may be investigated in great detail. There is here, certainly, a field for investigation.

A MEMBER:—I heard a little incident that may have some bearing on the question of pressing of spectacle lens where a quick, hard action was used instead of a slow, squeezing action. The lens had more tendency to show cracks on the surface due to quick cooling cracks, which the slow squeezing action eliminated.

DISCUSSION[1] ON "A SMALL GLASS TANK"

MR. BELLAMY:—Mr. Chairman and gentlemen, I feel that I should apologize for this paper. After I announced my intention of writing it, I got a letter from Dr. Tillotson asking me to send the paper by return mail, and it was written rather hurriedly. There is one thing you should bear in mind; that we are making glass in much the same manner that a large manufacturer would run his brass melting establishment, and there are many things that come up in our case that do not apply to a large scale production. However, there are some points that will come out in this short paper that may be of interest. In the meeting this morning was discussed the use of blue-water gas for glass melting. We have used blue-water gas for four or five years in melting small quantities of glass, and we have never noticed any serious defects in the glass. However, there is a point that may come up in using it in very large quantities, and that is the formation of iron carbonyl. Blue-water gas passing through the mains comes in contact with the iron and small quantities of iron carbonyl are formed. This product is an unstable gas decomposing, when heated, into carbon monoxide and iron oxide which would of course affect the color of the glass.

[1] Bellamy, *Jour. Amer. Ceram. Soc.*, 5, 157–60 (1922). Glass Division, St. Louis Meeting, Feb. 28, 1922.

THE CHAIRMAN:—Mr. Bellamy's paper is open for discussion.

MR. WRIGHT:—Mr. Bellamy spoke of using zirkite brick in the crown. He first spoke of silica brick and their tendency to spall. The zirkite brick wasn't used then for its higher heat resistance—higher effectiveness.

MR. BELLAMY:—It was used principally to withstand the severe action on the arch of the flames playing directly on it. Heat resistance also needed for this arch is insulated with a platen of fire brick and about six inches of Sil-O-Cel, so that the top of the crown is not over 100° Centigrade.

MR. HOSTETTER:—In ordinary performance, we find above the middle line it attacks fire clay very rapidly, and it doesn't attack the silica brick. Can you tell something about the attack any the zirkite brick?

MR. BELLAMY:—There is scarcely no action on it.

A MEMBER:—You mean to say you had it insulated?

MR. BELLAMY:—Yes, $4^1/_2$ inches of zircon brick with a course of fire brick laid flat, and then possibly five or six inches of Sil-O-Cel above.

MR. DIXON:—How much glass did the tank hold?

MR. BELLAMY:—About five or six hundred pounds.

MR. DIXON:—How long did you operate it?

MR. BELLAMY:—About a year.

MR. DIXON:—Is that the same tank that is in operation now?

MR. BELLAMY:—Yes.

MR. DIXON:—What kind of glass did you have?

MR. BELLAMY:—High lead glass.

MR. DIXON:—Did you say the capacity of the furnace was five or six hundred pounds?

MR. BELLAMY:—Yes.

MR. DIXON:—Is it daily, intermittent or continual? You put it in the night before? Daily melting?

MR. BELLAMY:—Yes, sir, daily melting.

MR. DIXON:—Have you no record of the temperature?

MR. BELLAMY:—Yes.

MR. DIXON:—What was it?

MR. BELLAMY:—Around 2400°F.

MR. DIXON:—And what did you say the crown was built of?

MR. BELLAMY:—Zirconium silicate. Don't confuse that with zirconium oxide.

MR. DIXON:—And this was insulated?

MR. BELLAMY:—Yes, sir.

MR. WATSON:—I would like to ask if this material is zirconium silicate.

MR. BELLAMY:—Yes, I want to emphasize that. It is not zirconium oxide, but zirconium silicate. It is a brick made by the Carborundum Company.

Mr. Watson:—That brick is of zirconium silicate.

Mr. Dixon:—Where is this concern located?

Mr. Bellamy:—Chicago.

Mr. Dixon:—May we come up and see it?

Mr. Bellamy:—I am not in a position to say that you can come to see it.

Mr. Dixon:—Well, you have made some statements that are very startling and I would like to see it, and would like to make some tests on it.

Mr. Bellamy:—You might send in a request to the Company. I am sure it would be favorably considered.

The Chairman:—Is there any particular trade name for these bricks as put out by the Carborundum Company?

Mr. Bellamy:—Zirconium silicate brick.

Mr. Brown:—In four or five or six hundred pound furnaces, you have an entirely different proposition than the most of us have to deal with.

Mr. Bellamy:—The arch is the hottest part of the furnace for the flames come from the burner and impinge on the arch where you get perfect combustion.

Mr. Brown:—What size is the cap?

Mr. Bellamy:—It is about 2 feet across and about 45 inches long.

Mr. Wright:—I believe we are all acquainted with the fact that some of the mineral companies are recommending zirkite brick for super-refractories and for crowns of small tanks and especially where high temperatures are obtained. We see their advertisements. I think this is one of the first statements we have had though from actual use and service. It may open up something of very much interest to everyone here.

Mr. Watson:—As I understand the gentleman he is not using zirkite brick but zirconium silicate, which is not the oxide, but the silicate of zirconium.

Mr. Bellamy:—Yes, it is not the oxide.

Mr. Wright:—Zirkite brick is one you can buy in three or four different grades. The cheapest grade contains nearly 50% of SiO_2 which is commercially speaking zirconium silicate. They put that out in goods commercially called zirkite brick.

Mr. Bellamy:—The zirconium silicate is handled by the Buckman-Pritchard Company and the brick by the Carborundum Company. They mix a little clay in with the powdered zirconium silicate to produce a cement in which to lay the brick. This arch has produced remarkable results in that there has never been a case of a piece of a brick spalling off. As the zirconium silicate does not harden, the arch has been taken apart brick by brick and set up again which is very desirable as the brick cost a dollar apiece.

Mr. Dixon:—Do you know any reason why a large furnace would not do as well as a small crown mixture?

Mr. Bellamy:—No sir.

Mr. Wright:—A dollar a brick?

Mr. Dixon:—Yes.

Mr. Wright:—Zirkite brick would have a specific gravity of 4.5, and silica brick is in the neighborhood of 2. The zirkite crown would be over two times as heavy as the silica brick crown.

Mr. Brown:—Did you insulate this cap?

Mr. Bellamy:—No, I didn't insulate the silica brick.

Mr. Brown:—It fell down?

Mr. Bellamy:—It cracked when the flames impinged upon it.

The Chairman:—I would like very much, since this subject has been opened up, to see if we can get one of the Carborundum Co. representatives to give information about this super-refractory.

Mr. Onan:—Mr. Bellamy has read a paper, I understand, on the work he has done with zirconium brick. The material used is not zirconium oxide but natural zirconium silicate. Very little work has been done by anyone other than ourselves on this particular material, and it is still in the laboratory. We are, however, producing some commercial size brick, and we are having some pretty good luck. In the glass tank furnace that Mr. Bellamy built it gave some remarkable service, and we have hope at an early date of trying it out on a larger furnace. Until that time arrives, we can not say just what it will do, or how it will do.

The material we are using is a distinct product. It is a natural combination you can not make up, and its action is not at all like that of zirconium oxide; very little spalling as with silica brick, and it has a very low heat conductivity quite contrary to our other refractories. We are in a position to furnish samples of this material to anybody who wants to look them over and give them a test, but as far as the product being perfected, or putting them on the market, it will be several months before we can do it. If there are any specific facts anybody wants to know, and I can tell them, if they will write to us, we will be very glad to go over the whole proposition.

The Chairman:—Have any of you questions you would like to ask the gentleman?

Mr. Watson:—I might state that in the Thompson Laboratory we have made some tests on zirconium oxide and zirconium silicate, and we find there is a vast difference in the two. While the tests are only in their infancy, we have enough data to know there is a considerable difference. One particular difference is the high resistance of the zirconium silicate over the oxide, also the small heating conductivity.

The Chairman:—Any further remarks? I certainly would be interested in getting a sample of the refractory. I imagine those present will take advantage of your offer to send samples. I certainly thank you for giving us this information about refractories; it is of great interest to all of us.

ACTIVITIES OF THE SOCIETY

BASEBALL SEASON ENDS WITH BIG SPURT

Manager Bowman Well Pleased with Team's Work

We had a hunch in the Secretary's office that September would see the dust flying on the diamond, and on the fourteenth of the month the forty-second runner slid across the home-plate, bringing the score six runs higher than any other month except the time of the Annual Meeting. Eleven of these, as Corporation Members, made home runs. This is something to tell the world, especially of a month containing ten dog days so doggone hot it was hard to sit at a desk and hold a pen in a perspiring hand long enough to sign on the dratted line.

The batting average follows:

	Personal	Corporation		Personal	Corporation
Chas. F. Binns	2		D. A. Moulton	1	
J. W. Cruikshank	2		Frank G. Roberts	1	
E. W. Dailey	1		Abel Hansen		1
W. W. Wilkins	1		H. F. Staley		1
Ellsworth Ogden		1	Alan G. Wikoff	1	
Chas. Laird	1		Herbert Goodwin	1	
A. M. Kohler	1		J. S. Herzog	1	
Geo. W. Shoemaker		1	J. L. Child	1	
E. P. Poste		1	Charles Brian		1
F. W. Butterworth	1		Gordon Klein		1
Joseph Johnson	1		Werner Malsch	1	
Fred T. Heath	1		H. H. Sortwell	1	
O. O. Bowman, 2nd		1	Donald Hagar	1	
Victor Barth	1		R. R. Danielson	1	
			Office	9	3

Total—31 Personal, 11 Corporation

The net increase for the first eight months of this year is:

	Personal	Corporation	Total
September 14, 1922	1539	199	1738
January 1, 1922	1350	139	1489
	189	60	249

The gross increase in membership by periods since June 1921 is:

	Personal	Corporation	Total
June to September 1921	41	11	52
September to December	18	2	20
December to February 1922	136	21	157
February to May	81	10	91
May	13	13	26
June	13	5	18
July	25	11	36
August	20	5	25
September	31	11	42
	378	89	467
Loss	82	5	87
Net increase	296	84	380

The football season is opening. Last month the goal was set at 200 personal and 100 corporation members.

The referee's whistle has blown. Three months to play, 169 personals, 89 corporations to go. Snap into it, men!

New Members Received from August 11 to September 14

Associate

Berry, Sydney G., Gifford & Bull, 141 Broadway, New York City, Patent Attorney.

Blake, Edwin M., Drawer A, Pratt Sta., Brooklyn, N. Y.

Campbell, A. M., P. O. Box 30, Perth, Ont., Canada, Mining Geologist.

Chivacheff, Louie H., Cornwall-on-Hudson, New York, Instructor Drawing and Manual Training.

Christie, Charles H., 602 N. McKean St., Butler Pa., Standard Plate Glass Company.

Coon, Darius A., Storrington Feldspar Co., Elgin, Ont., Canada, President.

Dorsey, Frank M., Nela Park, Cleveland, Ohio, Consulting Engineer, G. E. Co.

Doughty, I. N., 223 Kentucky Ave., Danville, Ill., Gen. Supt., Western Brick Company.

Elliott, Harry C., Cascade China Co., Portland, Ore., Pres. and Treas.

Gandette, Charles A., 661 New Willow St., Trenton, N. J., Trenton Potteries Co. Laboratory.

Gifford, Maurice S., 142 Osborne Ave., Libertyville, Ill., Chief Chemist, Chicago Hardware Foundry Co., North Chicago, Ill.

Green, John R., 319 S. Maryland, Mason City, Ia., Ceramic Engineer, North Iowa Brick & Tile Co.

Greer, W. Russell, 1938 Linden Ave., Baltimore, Md., Porcelain Enamel & Mfg. Co.

Ingler, William J., Holophane Glass Co., Inc., Newark, Ohio, Asst. Supt.

Jarmuth, Otto C., 9120 Commercial Ave., Chicago, Illinois, Art Director.

King, Robert Maynard, Box 103, Sta. A., Columbus, O., Student, O. S. U.

Kleymeyer, Henry C., Standard Brick Mfg. Co., Evansville, Ind., Gen. Mgr.

Lambert, Frank B., Illinois Brick Co., Chicago, Ill., Gen. Supt.

Landers, William H., 4 West 43d St., New York City, Consulting Engineer.

Marr, William H., c/o Canadian Libbey-Owens Sheet Glass Co., Hamilton, Ont., Canada, Supt.

Moller, Knud J. Chr., 4956 McPherson Ave., St. Louis, Mo., Chem. Engineer.

Owen, Frank E., The Findlay Electric Porcelain Co., Findlay, O., Sec. and Mgr.

Schroeder, Fred W., U. S. Bureau of Mines, Seattle, Wash.

Shearer, Walter L., 3044 Dent Place, N. W., Washington, D. C., U. S. Bureau of Standards.

Smith, Stanton G., Box 94, Auburn, Me., Maine Feldspar Co., Mgr.

Smith, Walter C., 654 St. Nicholas Ave., New York City, Sales Mgr., N. J. Pulverizing Company.

Taylor, Mark A., Terminal Bldg., Ft. Dodge, Iowa, Ceramic Eng., Vincent Clay Products Company.

Thompson, J. S., The Excelsior Dental Mfg. Co., Grace Road, Aintree, Liverpool, England, Managing Director.

Walker, Thomas C., Mosaic Tile Co., Plant No. 2, Matawan, N. J., Ceramic Engineer.

Winton, Lewis B., Great Barrington, Mass., Gen. Mgr., Stanley Insulating Co.

Zimmer, Daniel B., 1381 Sedgwick Ave., New York City, Treasurer, Vitreous Enameling & Stamping Co., Inc.

Corporation

Auld Co., D. L., 5th St. and 5th Ave., Columbus, Ohio.

American Stove Company, 2001 S. Kingshighway, St. Louis, Mo.

The Clay Products Co., Brazil, Indiana.
Fords Porcelain Works, Perth Amboy, N. J.
Metal & Thermit Corp., 120 Broadway, New York City.
N. C. Geological & Economic Survey, Chapel Hill, N. C.
Paper Makers Importing Co., Inc., 640 N. 13th St., Easton, Pa.
The Patterson Foundry & Machine Co., East Liverpool, Ohio.
Springfield Paving Brick Co., Box 403, Springfield, Ill.
The Trenton Potteries Co., Trenton, New Jersey.
The Vitreous Enameling Company, 71st and Grant Ave., Cleveland, Ohio.

Who's Where in the American Ceramic Society?

T. S. Curtis, president and general manager of the Vitrefrax Company, has notified the office of a change of address from North Rugby Avenue to 534 S. Seville Street, Huntington Park, Los Angeles, Cal.

Cedric L. Rennieburgh has recently taken a position with the A. C. Spark Plug Company, at Flint, Mich. Mr. Rennieburgh was formerly with the American Encaustic Tiling Company, Zanesville, Ohio.

W. W. Ittner has moved from Pershing Avenue to 2107 Park Avenue, St. Louis, Mo. His connection with the General Clay Products Corporation as treasurer continues.

George W. Hasslacher, of the Roessler & Hasslacher Chemical Company, sailed for Germany on September 16. He will be located for some time at the Deutsche Gold and Silber Scheideanstalt, Frankfurt, a./M.

H. M. Reed has moved from Pittsburgh to 106 Dixon Avenue, Ben Avon, Pa.

Ira E. Sproat took charge, on September first, of the Ceramic department of the R. T. Vanderbilt Company, New York City.

Waller Crow, formerly secretary-treasurer of the Schaffer Engineering and Equipment Company, Pittsburgh, Pa., is now president of his own company, Waller Crow, Inc., Chicago, Ill.

J. Alfred Dennis, of the Golding Sons Company, has been made superintendent of the Golding-Keene Company, Keene, N. H.

F. P. Hall, of the Bureau of Standards, Washington, has changed his residence from Crittenden Street to 630 Webster Avenue.

J. Ellis Harvey, general manager of the Centre Brick and Clay Company, is now located at Ridgway, Pa.

Arthur L. Koch gives as his new address, 1748 Wellesley Avenue, St. Paul, Minn.

J. B. Owens, of the Empire Floor and Wall Tile Company, has moved from Zanesville, Ohio, to 137 West 25th St., New York City.

R. R. Shively has just been appointed chief technologist for B. F. Drakenfeld & Company, New York City, where he will be technical advisor to the officers of the company. For eleven years Dr. Shively has served as industrial fellow at Mellon Institute, where he has specialized on glass and glass-making materials.

M. G. Babcock, formerly of the Pittsburgh office of the Laclede-Christy Clay Products Company, has been transferred to their Rochester plant, to handle the sales of all glasshouse refractories manufactured there. Mr. Babcock's territory will comprise all pot glass manufacturers in the United States and Canada.

T. M. McVey, recently of the Lacon Clay and Coal Company, Lacon, Illinois, has been appointed instructor in the Ceramics department at the University of Illinois.

T. W. Garve, recently located at Watsontown, Pa., has returned to Columbus, and may be found at 47 North 20th Street.

Herman Coors, who severed his connection with the Coors Porcelain Company some time ago, is now established at 3768 Dalton Avenue, Los Angeles, Cal.

A. Malinovszky, formerly with the U. S. Smelting Furnace Company, Belleville, Illinois, has gone to Long Beach, California.

H. P. Reinecker, formerly with the Bureau of Standards, Washington, has accepted a position with the Pacific Enameling and Manufacturing Company, Oakland, Cal.

Robert F. Sherwood, has left the Muncie Clay Products Co., Muncie, Ind., and has taken a position with Pass & Seymour, Inc., at Syracuse, N. Y.

Chester Treischel has been transferred by the General Electric Company to the Pittsfield works, Pittsfield, Mass.

Carl G. Zwerner, who has been with the Northern Clay Company, Auburn, Wash., for some time, has returned to Columbus, where his address is 58 West Tenth Avenue.

Addresses Unknown

Any information as to the whereabouts of the following members of the Society will be gratefully received by the Secretary's office. Mail has been returned from the addresses given.

Baker, G. V., Penn Feldspar Co., Philadelphia, Pa.
Bickel, Earl A., Postville Clay Products Co., Postville, Iowa.
Bramlett, Mrs. J. T., Enid, Miss.
Brett, R. C., Southern Clay Mfg. Co., North Birmingham, Ala.
Buckner, O. S., 44 Wellington St., Worcester, Mass.

Callaghan, J. P., c/o Teaque Hotel, Montgomery, Ala.
Curran, Hugh, Bakersfield Sandstone Brick Co., Bakersfield, Cal.

Dolley, Charles S., Keramoid Mfg. Co., Fort Madison, Iowa.

Fiske, J. Parker B., Arena Bldg., New York City.

Greenwood, John L., Lehigh Sewer Pipe and Tile Co., Lehigh, Iowa.

Hall, Herman A., McLain Fire Brick Co., Vanport, Pa.
Henshaw, S. B., Libbey-Owens Sheet Glass Co., Charleston, W. Va.

Knote, J. M., Mines Dept., L. S. Corp., Sault St. Marie, Ontario.

Meissner, Max, Sprague Canning Machine Co., Hoopeston, Ill.
Miller, J. J., Mellon Institute, Pittsburgh, Pa.
Mitchell, Leon W., Rock Island Stove Co., Rock Island, Ill.
Mulholland, V., 41 Arch St., Hartford, Conn.

Nagle, J. A., 196 Oak St., Columbus, Ohio.

Pendrup, W., Coonley Mfg. Co., Cicero, Ill.
Pire, Mrs. Ward L., 1745 East 116th Place, Cleveland, Ohio.
Pulsifier, H. M., Geo. H. Holb & Co., Chicago, Ill.

Ragland, N. A., Alberhill Clay and Coal Co., Los Angeles, Cal.
Reid, W. H., 10 Stanley Place, Yonkers, N. Y.

Stewart, John G., 530 Union Trust Bldg., Cincinnati, Ohio.

Tefft, T. D., Hamilton, Ont.
Trace, A. R., National Fire Proofing Co., Hobart, Ind.

Vodick, William J., 1733 Lake Ave., Wilmette, Ill.

Yamamoto, Tamesburo, Yamatame Glass Mfg. Co., Osaka, Japan.

Exhibit of Ceramic Wares

Twenty-fifth Anniversary Convention, Feb. 12–17, 1923

The Art Division, under the chairmanship of Frederic H. Rhead, is planning an exhibit for this convention. Plans have not as yet been fully formulated but the occasion suggests the scope and character of the exhibit desired.

The several Divisions will be asked to coöperate in making an exhibit illustrative of the twenty-five years of development in their respective industrial groups. Ample space conveniently located has been secured in the hotel.

The American Ceramic Society at the Chemical Show

By Alan G. Wikoff

The American Ceramic Society was well represented at the Eighth National Chemical Exposition the week of September 11. At the opening meeting President F. H. Riddle[1] gave an address; Friday, September 15, was "Ceramic Day" when a program of fifteen papers was presented before an audience of 150. Two booths were maintained throughout the week as headquarters for the members of the Society.

Mr. Riddle's talk on "The American Ceramic Industry" was an excellent presentation of a subject which is gaining daily in importance to the world. His definition of the term "ceramic" was careful and his classification of the ceramic branches concise and of vital interest. The paper discussed further the following points:

1. Standards for Purchase
2. Industries Described
    - (*a*) Hollow-ware
    - (*b*) Architectural Terra Cotta and Tile
    - (*c*) Brick
    - (*d*) Glass
    - (*e*) Enameled Steel and Iron
    - (*f*) Abrasives
    - (*g*) Refractories, Silica, Aluminum, Magnesia, Etc.
3. Progress of Ceramic Work during the War
    - (*a*) Development of Better Refractories
    - (*b*) Enameled Iron
    - (*c*) Chemical Stoneware
    - (*d*) Graphite Crucible
4. Relation between Ceramic Interests
5. The American Ceramic Society

Ceramic Day formed a fitting climax to the technical programs held in conjunction with the Eighth National Exposition of the Chemical Industries. At the afternoon session papers of a high order of merit were presented on a variety of ceramic subjects. The meeting was exceptionally well attended and those in the audience who were not members of the American Ceramic Society took away with them a clearer conception of the importance and magnitude of the ceramic industry. They realized, perhaps for the first time, the many points at which this industry touched their daily lives. For the members there was much of real technical value, and the assimilation of important information was facilitated by carefully prepared lantern slides and ingenious models in several instances.

[1] This paper will be published in full in this *Journal*, January, 1923.

The following papers were given:

W. H. Gaylord, Jr. (Quigley Furnace Specialties Co.), "High Temperature Cements."

E. S. Hirschberg (Ding's Magnetic Separator Co.), "Application of Magnetic Separator in Ceramic Industries."

G. D. Dickey (Industrial Filtration Corporation), "Preparation of Clays and Minerals for Ceramic Purposes."

Eric Turner (Trenton Flint and Spar Co.), "Apparatus for Quickly Determining Fineness of Grind."

W. H. Landers, George M. Darby, O. O. Bowman, 2nd, August Staudt, C. R. Moore, C. M. Franzheim, "Feldspar Colloquium."

H. C. Arnold, "Manufacture of Gray Enameled Ware."

A. E. Williams, "Whiting for Ceramic Uses."

C. B. Chapman (Chapman Engineering Co.), "Gas Producers for Glass Works."

Paul E. Cox, "Witchery of Glazes."

Conrad Dressler, "Architectural Faience and Its Artistic Possibilities."

Frederic H. Rhead, "Organization of a Decorative Ceramic Research Department: Financial and Manufacturing Considerations."

Earle N. McGee (Semet-Solvay Co.), "Testing Refractories."

Charles E. Kraus (Johns-Manville Inc.), "High Temperature Cements."

F. P. Nickerson (W. S. Tyler Co.), "Sieve Testing of Ceramic Materials."

H. F. Kleinfeldt (Abbé Engineering Co.), "The Grinding of Ceramic Materials."

In the evening, the Society contributed two important papers to the symposium on Standardization arranged by the New York Section of the American Chemical Society.

1. Ross C. Purdy discussed some of the problems encountered in attempting to standardize fire clays and refractories.

2. Emerson P. Poste presented a series of lantern slides illustrating what is being accomplished toward the standardization of enameled wares for chemical purposes.

NOTES AND NEWS

Calendar of Conventions

The Silver Jubilee of the American Ceramic Society will be celebrated at the next Annual Meeting which is noted on this list. Watch for the announcements as they appear in other portions of this *Journal*.

American Mining Congress—Cleveland, Ohio, October 9–17, 1922.

Society of Industrial Engineers—New York City, October 18, 1922.

National Association of Commercial Organization Secretaries—Chicago, Ill., October 23–25, 1922.

National Society for Vocational Education—Detroit, Mich., November 30–December 2, 1922.

Dental Manufacturers Club—St. Louis, Mo., November 20, 1922.

Dental Exhibit of the Dental Manufacturers Club—St. Louis, Mo., November 21–24, 1922.

National Exposition of Power and Mechanical Engineering—New York City, December 7–13, 1922.

Mining and Metallurgical Society of America—New York City, December 7–13, 1922.

American Malleable Castings Association—Cleveland, Ohio, January 10, 1923.

National Jewelers Board of Trade—New York City, January 18, 1923.

Canadian National Clay Products Association and Western Ontario Clay Workers Association—Hamilton, Ont., January 24–26, 1923.
American Concrete Institute—Detroit, Mich., February, 1923.
National Association Builders Board of Control—Des Moines, Iowa, February, 1923.
AMERICAN CERAMIC SOCIETY—Pittsburgh, Penna., February 12–17, 1923.
National Gas Association of America—Louisville, Ky., Spring, 1923.
American Institute of Mining and Metallurgical Engineers—New York City, February 19–22, 1923.
National Association of Stove Manufacturers—Richmond, Va., May 9–10, 1923.
American Association of Museums—Charleston, S. C., May, 1923.

I STEEL FOUNDRIES COOPERATE IN JOINT RESEARCH
II COORDINATING FOUNDRY CONTROL
III SCIENTIFIC INVESTIGATIONS LEAD TO BETTER PRODUCT
IV IDEAS FREELY INTERCHANGED

These headlines appeared in a recent issue of *The Iron Trade Review.*[1] The stories told were of the coöperative research and plant control in which five steel foundries are engaged under the direction of Major R. A. Bull. Electric Steel Co., Chicago; Fort Pitt Steel Coasting Co., McKeesport, Pa.; Michigan Steel Casting Co., Detroit; Sivger Steel Casting Co., Milwaukee are thus coöperating.

With improved quality as the goal and diligent teamwork as the means to that end group research has proved its worth to associated manufacturers producing a common product. No more trying conditions could be imagined for testing the worth of coöperative research than the depression which has marked almost the entire period of the association of five progressive steel casting manufacturers in the Electric Steel Founders' Research Group. While some large manufacturing interests possessed of practically unlimited means have cut their research appropriations to the bone, have lightened their overhead by reducing and even in certain cases dismissing entire research staffs, abandoning projects and sacrificing results of years of endeavor, this small body of steel casting producers has held steadily to its purpose, sustained by its faith in the ultimate outcome. Consequently, its members, emerge into the period of keen competition at hand well equipped in shop methods, quality of product, and organization morale.

This statement may seem exaggerated to those who are not familiar with the breadth and character of the work being done by this group. It will be difficult to understand without a knowledge of the accomplishments of the plan how, for example, the organization morale of the individual members could be appreciably benefitted. However, this assertion is fully supported by a familiarity with the facts which have been established. The idea of group research and coöperative effort between five manufacturers making a similar class of steel castings had its inception early in 1920, when in response to a call by C. R. Messinger, of the Sivyer Steel Casting Co., a meeting was held in Pittsburgh, Feb. 25, 1920. Here a plan was outlined whereby technical problems could be solved by the combined efforts of the foundries associated.

Obviously, the basic requirements of an association of this character were implicit confidence between the members and the unselfish interchange of data. How well the idea has been carried out will be evident from the results attained. Improvement in quality of product, the underlying purpose in forming the group, required the supervising control of a recognized expert in steel foundry practice. The company secured the exclusive services of Maj. R. A. Bull, who had long been a dominant figure in the industry through his association with the Duquesne Steel Foundry Co., as Vice President

[1] D. M. Avey, page 1472. *The Iron Trade Review,* May 25, 1922.

and General Manager, and previously with the Chicago Steel Foundry Co., the Commonwealth Steel Co., and the American Steel Foundries. Major Bull's activity in the American Foundrymen's Association, of which he was president in 1915 and 1916, had further fitted him for the task of organizing and correlating the staffs of the various members of the group. The wisdom of his selection is attested by the ready response and hearty coöperation observed among the superintendents, foremen and workmen in their attitude toward the research director, as Major Bull is termed.

Recognizing, from the first, the dual nature of the problems to be encountered, a working organization within the group was formed. This had two controlling committees, the general committee, having the decision on questions of policy, finance, and cost; and the technical committee, dealing with operating problems. At present these committees are made up as follows:

General Committee

Chairman, C. R. Messinger, vice president and general manager, Sivyer Steel Casting Co.
R. F. Flinterman, president, Michigan Steel Casting Co.
C. S. Koch, president, Fort Pitt Steel Casting Co.
John M. Olmsted, vice president and general manager, Electric Steel Co.
T. S. Quinn, treasurer, Lebanon Steel Foundry.

Technical Committee

Chairman, William J. Nugent, vice president and works manager, Electric Steel Co.
R. J. Doty, vice president and works manager, Sivyer Steel Casting Co.
C. S. Koch, president, Fort Pitt Steel Casting Co.
T. S. Quinn, treasurer, Lebanon Steel Foundry.

The question of selling prices for castings was banned from the start. Costs were considered only as an abstract problem; but the scientific study of costs to bring about more economical manufacture while maintaining and, when possible, improving quality, has been one of the most beneficial results of the association.

The group's scheme of operation may be briefly indicated under five main heads. Broadly speaking, the results are obtained through the following means: Frequent meetings of group representatives; investigations authorized at these conferences and conducted at suitable plants; general inspections of each plant by the research director; transmission regularly of reports to and from the director; and the use of the director's office as a clearing house and distributing center for all technical information of value to the members.

The meetings are held frequently and usually last for three days. In most cases they are held where one of the member plants is located and each such plant is visited at a time when the greatest benefit may result from critical and thorough examination by all representatives of the accomplishments of the investigation at that time justifying joint consideration on the ground. These meetings are attended by the principal operating executives themselves and, as occasion may warrant, by some of their chief subordinates in close touch with the problems under consideration. Consequently, questions of operating expediency can be decided immediately through the authority vested by each company in its delegated representatives. The great advantage of this will be obvious.

A typical meeting is a scientific convention in miniature. The members to whom the group has delegated specific researches are required to present detailed written reports of these investigations showing the progress to date. These reports are mailed by the authors to each of the plants and to the director sufficiently in advance of each meeting to permit prior study by all conferees. The critical consideration given these progress reports is exhaustive, and leads to agreement as to the further steps for each investigation. These occasionally require the participation of more than one plant in one research to test the application of a theory under different local conditions. Supplementing the reports by the members, the research director analyzes the status of the

work and presents for consideration such additional problems for investigation as he feels profitably may be attacked next. Before adjournment, definite decision is reached on all matters the solution of which is possible, thus permitting the group to function with the utmost dispatch.

Research in each case is assigned to the plant believed to have the most suitable personnel and equipment for the purpose after recommendation along these lines by the director. Such an investigation is conducted at joint expense. It requires the immediate supervision of a properly qualified man who in many cases for a time may be the operating head of the member plant. In every instance this individual is held responsible. The serious manner in which the work is carried on will be apparent from this. The man on the ground making an investigation is given all possible assistance by the director who periodically visits the plant for personal participation in the researches under way. An exhaustive record is kept of every detail of each research. Therefore, the complete series of progress reports on any investigation is convincing.

FEDERAL SPECIFICATIONS BOARD

U. S. Bureau of Standards

When General Dawes started to put the budget system in operation in the various Departments of the Federal Government, it soon became apparent that it would be necessary, in order to inaugurate an effective purchasing system, to first provide specifications for a vast number of articles. Considering the fact that Government specifications have long been a bugbear to those who have had experience with Government Departments as customers, it might seem that there were too many Government specifications already. Since in many instances, different Departments had different specifications for the same thing, this may have been the case; the need was not for more specifications but for *one* adequate specification for each product or material. Standards of quality had to be established and uniform specifications prepared.

In order that this stupendous undertaking should be carried out systematically, a new agency, to be known as the Federal Specifications Board, was created by executive order. It was entirely logical that Dr. Stratton, Director, since its founding twenty-one years ago, of the Bureau of Standards, should be made chairman of this new board which has to pass on all specifications prepared for the use of the Government Departments. It is a matter for mutual congratulation, considering the standardization work that is being undertaken by the AMERICAN CERAMIC SOCIETY, that the Director of an institution which is already working in close coöperation with the Society should be at the head of the organization which is to unify the government standards.

Germany Tending to Impress its Industrial Standards on All Import Countries

American Engineer, Back from Germany, Reports Industries There Gaining Big Advantages through Standardization

"The day may not be far distant when American manufacturers will receive inquiries from oversea countries to furnish goods according to the German national standards, and it behooves us to plan in time to meet such conditions."

This statement is contained in a communication to the American Engineering Standards Committee from Oscar R. Wikander, an American engineer, who has just returned from Germany, where he represented the A. E. S. C. in conferences concerning the international standardization of ball bearings.

Describing the great strides in standardization that have been made by German industries during the last few years and the important foreign trade advantages accruing to German industries because of their intense standardization activities, Mr. Wikander said:

"There is no doubt in my mind that one of the main reasons why forward-looking Germans force their standardization work is because they want to introduce German standards in the great importing countries, and possibly in the whole world. Holland, Switzerland, Austria, Sweden, and many other European countries follow the German lead very closely. The great German deliveries in kind to France will no doubt be made as far as feasible according to German standards, thereby introducing them in that country.

"It was only a few years ago that the 'Normenausschuss der Deutschen Industrie,' an organization corresponding to our American Engineering Standards Committee, was formed but the amount of work which it has already accomplished is stupendous. The 'Normenausschuss' has already issued several hundred sheets of approved standards, and about twice as many are already published as proposed standards. This enormous output of the German organization has led many to believe that it was merely a factory, producing 'paper standards,' and that its work was not to be taken very seriously. A personal investigation convinced me that this is not the case, and I found that the great output of standards was merely due to the enormous efforts put forth and to the enthusiasm of the great majority of the interested parties.

"This enthusiasm is due to a more or less general recognition, created under the pressure of war conditions, of the great economic value of standardization, and to the very generally accepted opinion that a standardized industry would be one of the strongest weapons in Germany's struggle for economic rehabilitation and financial reconstruction.

"To give a concrete illustration of this point, I may mention that at the time of my visit, a syndicate of nineteen German manufacturers and one Swedish manufacturer were executing an order for seven hundred locomotives for Russia, all of the same design, and every part in every one of them was being made interchangeable with the corresponding part in all the others, all parts having been manufactured to the same fits and tolerances. This feature will have the great advantage of permitting the Russian railroads to use any disabled locomotive as a store of spare parts for all the others. In one case a locomotive was assembled from parts machined in twenty different shops, with no more difficulty than a locomotive which was built complete in one shop. In case of future orders, the Russians will no doubt specify that all new locomotives of this class be built not only of the same design as above, but so that every part is interchangeable with the above.

"It is easy to realize what great advantages German manufacturers of locomotives will have over those of other nations when competing on the basis of such specifications, and this example illustrates the economic advantage which can be gained by German industry in introducing its standards in all countries importing mechanical equipment.

"Another error in our conception of German standardization is the belief that the 'Normenausschuss' is autocratic in its methods and is not in as close contact with the industries as our own standardizing bodies. I found, on the contrary, that absolutely the same methods are used there as here to arrive at national standards. The staff of the 'Normenausschuss' is merely coördinating and directing the work of the various committees, and the actual work in establishing standards is left to such experts as are recognized leaders in the various industries.

"The 'Normenausschuss' is a big organization built up along the same lines as the American Engineering Standards Committee. Its personnel consists of the same high

grade type of men as selected in this country for that kind of work,—only there are more of them and their work is greatly facilitated on account of the eager response from the German industry, whose leaders look to standardization as one of their greatest hopes for salvation.

"Many of the big German manufacturers have standards departments of their own, with a number of engineers and draftsmen working permanently on national standards. I found the staff of the 'Normenausschuss' greatly interested in American standardization and very anxious to collaborate with us in establishing international standards.

"It was proposed that they should send the American Engineering Standards Committee all the drafts of any importance submitted to their own committees for consideration, so as to make it possible for them to obtain American comments on important propositions, which might be of value in making final decisions. It was also suggested that the American Engineering Standards Committee keep the 'Normenausschuss' posted on its more important work. It would, of course, be highly desirable to establish international standards and great efforts are being made to obtain them in certain lines, such as ball bearings.

"The days may not be far distant when our manufacturers will receive inquiries from oversea countries to furnish goods according to the German national standards or specifications, as referred to above in connection with the Russian locomotives, and it behooves us to plan in time to meet such conditions, England seems to have realized fully the importance of recognition of her standards, and is trying to force the adoption of them in her colonies and dominions.

"On account of its very efficient organizations, the German Standards Committee has come to play a more important rôle in the industrial life of the nation than originally expected and manufacturers write to the 'Normanausschuss' for advice on questions of the most intricate nature.

"In conclusion I wish to express the hope that the example of the German engineers and manufacturers may spur us to make equally large contributions in work and money to the cause of standardization, and that our leading engineers may try to realize the enormous economic importance of both national and international standards."

Storage and Transportation of Portland Cement

(With a Bibliography)

By W. M. Myers (Assistant mineral technologist, U. S. Bureau of Mines).

The U. S. Bureau of Mines conducted an investigation to determine the cause of the deterioration of Portland cement during storage and transportation, and to discover a means of preventing it. All available printed sources of information on this subject have been examined and a bibliography has been compiled. The subject has also been discussed with the leaders in the cement industry; the present report is the result of their coöperation, and is based principally on information thus obtained.

Deterioration of Portland cement during storage over any considerable period of time has long been noted; closely related to it is deterioration of cement during transportation, which involves not only the time factor of storage but also exposure to varied climatic conditions. Deterioration in both cases is due to hydration of the cement by absorption of moisture from a humid atmosphere, or by exposure to actual rain-fall. After hydration cement possesses no cohesive power; the degree of deterioration is directly proportional to the degree of hydration.

The amount of deterioration of Portland cement during storage has been accurately determined in an investigation by the Structural Materials Research Laboratory, in

coöperation with the Portland Cement Association. Cement stored in a shed in cloth sacks retained 80 per cent of its original strength after three months' storage; 71 per cent after six months; 61 per cent after one year; and 40 per cent after two years.

Storage and Transportation of Portland Cement in Bulk.—Deterioration of cement stored in bulk is less than in bags, owing to the smaller area exposed. Hydration takes place only at the exposed surface, and the bulk of the cement is unaffected. Cement transported in bulk must be shipped in a tight, closed car, and must be protected from moisture during loading, shipping, and unloading, preferably it should be used immediately after unloading at the point of destination. This practice is now followed by several manufacturers and where conditions are suitable it is becoming more common as its advantages are seen. Shipping in bulk effects a saving by eliminating the use of bags—which is an important item in the cost of cement and it should also permit a saving in freight rates.

Storage and Transportation as Unground Clinker.—Clinker, the fused product of the cement kiln before it is ground to form the finished Portland cement, is exceptionally well adapted for transportation or storage over long periods of time under adverse conditions. It is extremely inert and has no tendency to absorb moisture. Experiments show that clinker may be stored under water, or subjected to alternate dry and wet storage, without lowering the quality of the finished cement.

This cement has two distinct advantages: The quality of the cement produced from stored clinker is higher, and the grinding cost of the clinker is decreased because of mechanical disintegration.

The improvement in the quality of cement made from stored clinker is due to the hydration of any free lime (CaO) that may be present. Free lime is injurious to the finished cement, as it produces unsoundness. It is not present in a perfectly burned clinker, but it is present occasionally as a result of imperfect mixing of raw materials and of careless manipulation. Cement manufacturers, therefore, generally store clinker for several weeks or months before grinding. Clinker that produced unsound cement in one instance was found to yield a satisfactory product after being treated with steam to hydrate the free lime.

Though Portland cement in the form of clinker is most carelessly handled and stored without regard to humidity or climatic conditions, yet improvement rather than deterioration of quality is manifest in the ground product.

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1922.	January	p. 11–14
1922.	February	p. 30–34

Management Week

The American Society of Mechanical Engineers has designated the period from October 16 to 21 as "Management Week" in order to stimulate interest in the solution of problems of management in industry. During this time meetings will be held by the Local Sections in coöperation with other engineering societies, including the Taylor Society and the Society of Industrial Engineers.

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BULLETIN
of the
American Ceramic Society

A Monthly Publication Devoted to Proceedings
of the Society, Discussions of Plant Problems, Discussions
of Technical and Scientific Questions and
Promotion of Coöperative Research

Edited by the Secretary of the Society Assisted by Officers of the Industrial Divisions

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EDITORIAL

THE VALUE OF DISCUSSIONS

Ability to reason distinguishes man from other animals, and men are distinguished from one another by difference in ability to reason logically, the successful men being those who are most logical. Ability to reason logically is one of the gifts not possessed equally by all men, nor can it be acquired by all to the same degree. Furthermore, no man is equally logical in all lines of thought. Most successful bankers would be less successful lawyers, and most successful works managers would be less successful accountants. Each man has his own calling, but in whatever line a man may be engaged his success will be in proportion to his ability to reason.

Experience has shown that the musician, the poet, the lawyer, the merchant, the works manager, the sales manager and the man in any of the other vocations will attain his greatest ability to reason only by continued orderly practice. Ability to reason in mathematics is acquired only by solving problems; in law by practicing law. Studying and thinking are requisites but reasoning power will be developed only when the things studied and the thoughts evolved are marshalled in an orderly fashion to some definite purpose, as one does when speaking or writing to convince or to make plain to another person. Just as surely as the weak points in design are discovered only in the detailing on the drafting board, so the defects in reasoning are brought out in written and oral discussions.

Unless man reasons through to a demonstrated fact he has not acquired knowledge or ability, in fact he will have nothing more than a jumble of experiences. Herein lies the benefit of participating in discussions and in the writing of papers.

Information will be acquired by those who hear or read the discussions and papers but by far the largest amount of definitely acquired knowledge and increased ability will accrue to him who does the telling, especially in debate for in discussion one must focus his experiences and observations in orderly reasoning to a definite conclusion. The reader will have the results but he who has marshalled his experiences, fitting them together to form a conclusion will have derived the greater benefit. It is he who has done the orderly reasoning from premises experienced, rather than he who merely reads or hears, who profits most in increased ability to reason, and it is he who has acquired the greater ability to reason logically who will best succeed in his chosen vocation.

The Silver Jubilee Convention to be held by this Society in Pittsburgh, February 12–16, 1923, and the Bulletin section of this *Journal* offer opportunities for the ceramist who wishes to develop reasoning ability to the maximum of his possibilities. These opportunities are taken by the most successful ceramists. These opportunities are for all who will use them and one so doing can count on the balance in benefits derived being in favor of those who take part in the discussions and of those who write up their experiences and observations.

COLLOQUIUM ON FELDSPAR

Correction

By V. A. Stout:[1]—On Page 139 in your August issue, *Bulletin* section, in the Colloquium of Feldspar and Feldspar Grinding, I note that I have made a very serious error in the calculation of the cost of power for grinding in the Hardinge Mill continuous system, as well as in the old system of chaser and batch mills.

This error consists in a decimal point, changing the figures as follows:

193 H. P. hrs. at 1½c per H. P. hr. divided by 3 tons per hr. = 96.5c per ton.

This changes the cost of milling per ton of ground spar for the Hardinge Mill continuous to $2.40 per ton.

By a very peculiar twist, the same error was made on the tabulation of costs per ton of ground spar by the old system and the first item should read:

Power at 1½c per H. P. hr. = $2.00

making these costs $4.90.

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The Editor has had conference with a few feldspar millers and users with whom he has met incidentally here and there with the net impression left that the most essential thing is a survey of the user's requirements, the permissible variation in composition, fineness and freedom from coloring and specking material.

The closed circuit continuous grinding provides for splitting the material from the mill according to size of grain, the coarse material being returned for further grinding. This is done for two reasons: (1) to insure that the entire product is ground to the minimum fineness and (2) to lessen the cost of grinding. With batch mills the product is ground under the given conditions of quantity charge and speed of mill until a wet screen test shows a given allowable residue on a 160-mesh screen, no separation of the sufficiently fine from that which is too coarse being attempted.

Practically all of the larger feldspar millers are credited with making a careful selection of the rock feldspar to insure uniformity of product and practical freedom from impurities. Each of them have established the confidence of the large users on the basis of this uniformity. Judging from the tons of discarded feldspar rock at one of the mills which, from casual inspection, appeared to be clean orthoclase, it seems true that the customers' requirements are the criteria of the character of the product which that mill will produce. This discarded feldspar, I am told, is giving satisfaction elsewhere. Hence, I assume that it was discarded at this mill because the product from it varied too much from that to which its customers were familiar.

One user requires two radically different feldspars, (1) easily fusible soda, and (2) refractory potash feldspar. The mixture in which the former is

[1] Received August 9, 1922.

used is not ground to pass a 40-mesh whereas the mixture containing the potash is finely ground. This user, therefore, has two widely varying specifications as to composition and fineness of grind. The soda feldspar used in the 40-mesh batch must be wholly 160 and finer, whereas the "run of mill" of the potash feldspar will satisfy the requirements of the finely ground mix.

One large user has just recently reported relative to tests of feldspar that they have been using Canadian feldspar for some time and that the principal objection has been that they were not ground uniformly although the manufacturers claim to grind to 140-mesh. "In the grinding of our ground coat enamels we grind it rather coarse as we find that we can manipulate the ground enamels best when they are not too finely ground. We usually grind our ground coat enamels to about 40-mesh and we have been troubled with small particles of substance that will not fire down in our muffles, protruding through the surface of the ground coat. Those small particles either make small defects in the finished ware or fall out in the finishing process and sometimes leave a small spot of exposed steel or a small bubble where the white enamels come in contact with the steel."

"After investigation we traced this down to the fact that there were unground pieces of feldspar in the material we have been using. These pieces in some instances are almost as large as small marbles and we find that they do not smelt in the smelting operation. We also find that they are only reduced in our grinding mills and many of these pass through the 40-mesh sieve, and since our ground coat, when it is fired, is not as thick as these unground pieces of feldspar, they protrude through the ground coat and cause the above explained trouble."

"We have purchased small lots of feldspar from several sources and on sieving it we find these unground pieces exist in every lot of feldspar we have purchased from the several well-known sources."

"When the enamels are not finely ground and the coats put on very thin, we find these unground particles are very objectionable."

A manufacturer of vitrified china has made the statement that no sample of feldspar submitted to him recently has been free from dark specks. The specks are not visible to the naked eye in the fused feldspar but are easily seen through a hand magnifying glass.

Another potter has said that he purchases feldspar on price basis from millers who have the capacity and intelligence to produce material that will be uniform from shipment to shipment, because all of them contain coarse material and none are free from black specking material.

Users of feldspar ground in batch, tube, and conical mills have like statements to make regarding the product. So far as is now known, the product has not been sufficiently improved to warrant the expense of air or screen separation of fine from the coarse, nor to attempt to free the

product from the iron impurities. This does not seem logical and it is not logical; there must be misdirected effort prevailing for it surely is true that the millers are now striving to produce quality feldspar.

If samples could be collected from the several producers, examined by petrographers and chemists, and tested thoroughly without prejudice, the ceramic trade could possibly work out practical specifications. With this, however, must be a survey of the quality requirements of the users. Will the feldspar producers and users unite in support of such an investigation?

Standard Specifications for Feldspar

By. W. H. Landers:[1]—It would seem that the discussion on feldspar has reached a point where little further progress can be expected until Standard Specifications are agreed upon. Of course such Standard Specifications will have to be within reasonable limits of the supply of raw material available and the ability of the millers to convert this raw material to these specifications.

Taking the first question, it will be recognized that regardless of whether the feldspar be soda, potash, or soda-lime-potash, the nature of its occurrence is such that the associated minerals, quartz, hornblende, tourmaline, magnetite, ilmenite, garnets and both the micas, will always be present to a certain degree. In many feldspars, graphite, manganese minerals, and sometimes chromite appear. Some unaltered pyrite is also found, although of rare occurrence.

With the long string of the above objectionable minerals, we have, according to whether the feldspar is mined from the surface or deeper deposits, some of the above in various degrees of alteration.

It is recognized that while all of these minerals do not occur at the same time in feldspar of each district, each one of them is supposed to constitute an impurity from the user's standpoint.

In considering Standard Specifications it would be well for the users in each industry to make known as soon as possible just what effect each one of these minerals exerts on their products. There is small likelihood that he is so familiar with this phase that he can at the present time answer this question.

It is also known that the amount of impurities present is the vital factor and that there is available at the present time no quick and accurate method of determining this percentage. This is particularly true of the R minerals of which garnet is the principal offender. What constitutes impurities to one branch of the trade is not necessarily an objection to another branch. For instance, in the glass trade, mica, some garnets and other minerals are not recognized as objectionable so long as the total

[1] Received August 9, 1922.

iron content is kept down to a very low limit. Silica cannot, within reasonable limits, have an adverse effect on the quality of the ware turned out, but enters into the question largely from a price standpoint. Free silica is difficult to determine in the laboratory, but total silica in the feldspar can be satisfactorily limited and this will automatically take care of the free silica question.

It is suggested that the user be liberal in this regard, and that specifications be adopted making more important the question of combined alkali, and limiting the amounts of other impurities.

The original condition of some impurities exerts a great influence on the appearance of the finished product, and the chemical analysis cannot be taken as the whole story. It has been found from experience that certain lots of feldspar from one district, while almost identical in analysis to other feldspars of the same district will fuse white in a biscuit kiln, while the other samples will have a slight brownish tint, both samples having previously given perfectly white buttons, free from visible spots, when fused in a gasoline or gas-fired muffle. These results were the same whether the feldspar had been ground wet or dry, and whether the ground feldspar had been "purified" after having been ground either wet or dry.

Just why this occurs is a matter for further research, and is quoted as tending to show how feldspar taken from one deposit may be expected to vary without visible warning. It has been suggested that this phenomenon is caused by the different degrees of oxidation of the iron minerals, and that when mining is confined to zones where the iron and R minerals are either pretty well oxidized or where they are unaltered, the ground feldspar resulting will be uniformly of one or the other color, *i. e.*, white or slightly brownish.

As this difference may be serious to only a small part of the trade, it is hoped that each of the three great users, manufacturers of pottery and tile, enamel ware, and glass ware, will adopt entirely separate Standard Specifications and that the miller will not be required to guarantee ultimate results when manufacturing within these specifications.

Lime.—From time to time one hears that lime is a detriment to the potter and that both the enamel and glass ware people use lime in their mix. Lime cannot be much of a factor as it rarely shows as more than a trace in the ground or crude feldspar, and is far more likely to creep into the ware, from the use of plaster of Paris moulds. Magnesia is generally present to a greater degree and should be discussed separately from lime.

Potash and Soda.—The question of the predominance of potash over soda, or vice versa is one for the user to decide as the millers in most districts are unable to mine or secure crude feldspar that does not contain both soda and potash.

Alumina.—The value or the effect of alumina seems to be very loosely discussed or understood, and one often hears one user say that alumina reduces the fusing point, and another makes just the opposite statement. They cannot both be right and the discussion should shed some light on this subject. The removal of garnets and mica cannot be accomplished without affecting the alumina contents.

Iron.—Iron in this, as in most chemical products is the "great bugaboo;" no matter what happens, the trouble is blamed on iron. With the exception of the glass trade where the effects of iron are definitely known, it does not seem clear, outside of the question of causing black specks in the ware, just what results from the presence of iron and whether the same effects are secured from the various oxides of iron as are noticed from the occurrence of metallic particles only.

It seems to be definitely established, however, that next to the elimination of iron to start with, its bad effects are considerably minimized by extremely fine grinding.

So far, no one has been able to prevent dark specks completely in the fused samples when these are examined under a magnifying glass. There is no excuse, however, for these specks to be of such a size as to be plainly visible to the naked eye. It represents bad milling practice or the improper choice of crude material.

It is safe to say that while today most of the grinding mills are extremely careful in their choice of crude feldspar, too much is taken for granted in the subsequent treatment of this crude material, and that plain engineering by some one not *too* familiar with the feldspar industry would greatly improve the quality of the product they turn out, especially as regards these iron specks.

Iron gets into the feldspar from many sources outside of its natural occurrence. First, we have that picked up in the mining operations, from the breaking and handling of the material with iron and steel implements. If the wear on these tools is considered, it would calculate too small a quantity to cause concern, but who has ever conducted an operation without noticing the presence in the material of all kinds of tramp metal such as nails, drill points, tobacco cans, links of chain, spikes, hammer heads, rivets, etc.?

When it is remembered that it takes only one small speck of iron to spoil the appearance of an expensive piece of china or tile, it will be realized that this matter is hardly one of definite percentages.

Secondly, as we move the crude feldspar either in mine cars, wagons, or in railroad cars, it is further subjected to contamination, and finally when the crude material gets into the mill, it already contains some considerable tramp iron minerals in the feldspar itself. Cinders from locomotives and hoisting engines, and large pieces of iron rust from open-top

cars, are among the various articles picked out by powerful magnetic head-pulleys, when such a device is used just prior to the grinding of the ore.

To any one who has had experience in the use of magnetic separators of the low intensity type, of which a magnetic head-pulley is a good example, it is at once apparent that the material eliminated at this point represents only the larger and more highly magnetic pieces. From the very nature of the design of the magnet, it can be expected that every large piece of feldspar will be moved aside to allow the feebly magnetic particle under it to be attracted.

There seems to be only one way to handle this problem of iron, and that is to use ordinary, good care in the choice and preparation of the crude material for the mill, and then to use such devices or processes in the milling, as will eliminate such iron either magnetic or non-magnetic, as may be enough to cause visible specks in the fused ware, without the use of a magnifying glass.

Considerable discussion has already taken place on the respective merits of sledging, followed by chaser stones, as against breaking in rock crushers, followed by further reduction in conical or cylindrical mills. It is a very difficult matter to exactly determine just how much iron is added in either case; the principal trouble being to take accurate head samples before the crude is reduced to a comparatively finely ground state. Measurements have been taken with great care, and over long periods of time, of the wear of jaw crushers when operating on various harder and softer rocks than feldspar, and some figures are available, as to the weight of metal worn away per ton crushed in the feldspar industry. This is so ridiculously low that one is inclined to question whether there is not actually as much iron added to the feldspar by hand sledging, plus the occasional broken hammer, and by the gears of the chaser stones, as may come from the more economical, and in every way more desirable rock feldspar.

It would be interesting to get an analysis of some of the chaser stones now used.

Passing these preliminary stages of coarse crushing, it will be seen that intermediate grinders, such as conical or cylindrical mills, have very little chance of adding any iron when lined with silex: this same applies to tube mills, either continuous or batch, although any one who has taken the gratings off the dump holes of batch mills and thoroughly cleaned them out is frequently surprised at what is found inside, in the shape of nuts, bolts, etc., that seem to have no reason for being there after all the agonizing care that has been taken to keep the feldspar away from iron.

During the milling process, the most prolific source of iron is from the types of conveying machinery generally used. Again we have the apparent necessity for the careful engineering of these problems by some one who is

not willing to accept present practice solely on the theory "that most mills have always used such."

As it is not the object of this contribution to enter into the respective merits of the various types of machinery, wet or dry grinding, or other factors such as costs, entering into the preparation of feldspar to meet Standard Specifications, this seems a good point to turn to the next mineral found in feldspar.

Mica.—Mica as generally found in feldspar is of two kinds: the muscovite, which is chemically harmless, and the biotite, which may contain iron either chemically combined or as isolated pieces of oxide between its laminations. One or both of these micas is always present in feldspar, and it becomes a question as to how much, or rather, in what form, mica can be permitted in the finished product.

Some members of the glass trade have stated that the presence of mica, other than its influence on the iron content, is no detriment in any form, but as much of the mica is practically infusible under conditions met in the pottery and enamel traces this question is reduced to that of how coarse can mica be permitted in the specifications.

It is entirely practical to eliminate most of the mica at certain stages of process, while grinding wet, but no way has been found to get it out in the dry state. As most of the feldspar comes at present from dry grinding plants, they will be chiefly interested in the fineness permitted.

Garnets.—So many types of garnet occur in practically all feldspars, that this question becomes one of prime importance. Most garnets are more fusible than the feldspar itself and have the objectionable property of spreading through the semi-fused enamel or glaze, and while not causing clearly defined spots, like iron, do result in somewhat off-color ware.

This problem of garnets will be one of the hardest to settle in adopting specifications, as there is no way of determining the exact percentage of garnets present. All garnets are not even slightly magnetic, but as they readily concentrate in a vanning pan, some method of estimating their amount may be developed; this has been done with approximate results by the miner in free gold mines, to determine the amount of gold in the ore.

The amount present can be substantially reduced in either the wet or dry state, but never can be entirely eliminated. How fine the remaining garnets are, can have little bearing on account of the lower temperature at which they fuse.

Tourmaline and Hornblende.—These are both silicates of the R series and may or may not cause off-color ware. For this reason, they form two of the objectional impurities in certain districts. It is barely possible that the allowable amount of these can be controlled along somewhat similar lines to garnets. This has been done quite successfully in a laboratory

way, but there is no available knowledge of a successful effort being made to reduce or eliminate either of these on a tonnage basis in process.

Coal Dust and Cinders.—These, if low in iron, seem to have no bad effect, but it is not definitely known just what part native graphite may have in producing off-color fusions; this matter can easily be determined by simple research, and should the graphite be objectionable, its almost complete removal can readily be accomplished in process.

Moisture.—The foregoing discussion covers only the question of impurities that may be present in the crude ore or picked up in process. There has lately developed a question of moisture or dryness, with the attendant one of lumps on the ground product.

As these lumps are composed of most finely ground feldspar and are only loosely cemented together by the small amount of colloidal matter present, they present a problem only to some of the enamel ware people. The finer the product is ground, either wet or dry, the more lumps will appear in the finished material when received.

Lumps are not peculiar to wet-ground material, but as their size, if not disintegrated before shipment, is more apparent, there have been some complaints on this score.

Many tests on dry-ground feldspar have indicated, especially when very fine, that depending on the humidity, it can be expected to take up from $^1/_2$ to $1^1/_2$% of moisture from the air, particularly when loaded warm.

Feldspar, when ground to pass 140-mesh, dusts very badly in handling but it contains less than 2% moisture, and this suggests that it might be much to the advantage of all concerned as tending to prevent losses and injury to the health of the workmen to allow, if not actually to require, from 2 to 3% moisture in the ground feldspar when received. Some states will undoubtedly legislate against *unnecessary* dust in this, as they have in other business.

The question of unground lumps will be discussed under the next topic, the all-important one of fineness.

Fineness.—Requirements as to fineness must be considered from the users' standpoint.

The *potter* can secure his feldspar ground from all of the present mills so that less than $^1/_2$ of 1% remains on 140-mesh Tyler standard screen. In some processes, what remains on 140 will be practically all mica which has previously gone through 100-mesh screen.

It is practically impossible where batch grinding is used, to guarantee the absence of large unground pieces, particularly bits of grinding pebbles, but in this case the balance of the feldspar will be much finer than 140-mesh, in order to average down the weight of these larger pieces.

There is no limit except that of time and cost, as to how fine feldspar can be ground, although it is a difficult matter to satisfactorily get a finer prod-

uct than that above, by the use of air separators operating in closed circuit, or by the use of screens which becomes impractical to the dry grinder, when he must use finer than 50-mesh cloth. These statements are not meant to imply that finer results cannot be attained when using air separators or screens, but that it would be impractical to do so with any hope of marketing ground feldspar at the present or a reasonably higher cost.

A very important specification would be a clean-cut adoption of some standard test screen, such as the Tyler Standard or a U. S. Standard; both cannot be used as there is quite a difference in the size of particle going through a given mesh in each.

Methods of grinding influence the range of sizes, but in general, if $^1/_2$ of 1% remains on 140, there will not be over 5% on 200. It would seem better to adopt as coarse a mesh as possible and reduce the amount allowed to remain on this in order to facilitate the making of screen tests, both at the mill and at the plant of the consumer; very fine mesh test screens are costly to buy, do not last long before becoming inaccurate, and consume too much time in their use.

Some potters propose to use a rising current of water of definite velocity as means of determining fineness. This will not do at all as a standard, for the reason that different feldspars settle at vastly different rates, according to the shape of each particle, which shape is somewhat influenced by the grinding method used and the amount of impurities present. A wet-ground feldspar may settle as fast as five times the rate of a dry-ground feldspar and yet both will give identical results on a complete screen analysis. A few degrees of temperature may greatly change results as may the presence in the water of various mineral salts or organic matter.

Test screens with a definite opening will give the only positive results, unless the potters demand feldspar ground finer than 200-mesh; this fineness can be practically attained only by grinding in water.

It is recognized that some potters may demand a different fineness for use in the body to that necessary for use in the glaze, but it would seem far more satisfactory for each user to put in his own equipment to take out some of the very fine feldspar for the glaze from his standard feldspar, leaving a residue free from colloidal matter and most likely in a better state for working up in his clays and other materials that enter into the body.

The *enamel* trade, from what little can be gathered (mostly from their complaints), would like to get a feldspar free from lumps, which would leave no residue on an 80-mesh screen, and contain no material finer than 250-mesh. Such a feldspar would be in the nature of an extremely fine sand, would contain no lumps of any description and would fuse far more easily than feldspar containing finer material which would tend to form lumps during their process. This feldspar would be an intermediate size

but might be difficult to produce at some of the present mills. It is worthy of discussion, however, as it is possible to produce such a feldspar at a reasonable cost.

An intermediate size such as this would contain fewer impurities than either the coarser or finer products.

This same trade at present is generally supplied with feldspar ground to pass a 40- or 50-mesh vibrating screen set on a steep angle, which gives a fineness of approximately 90- to 100-mesh, but it does not guarantee that it will not contain quite a few pieces of 40- or 50-mesh material. The air separators on this product give about the same result.

The *glass* manufacturer uses comparatively coarse glass sand, some as coarse as 30-mesh, and it would seem that there would be no objection to their using feldspar of approximately the same fineness.

They could quite profitably use feldspar which had passed through 40-mesh but remained on 100, and contained not over 10% finer than 100. Such a feldspar sand can be very cheaply produced on a tonnage basis, will give very little dust in handling, and will be naturally of low moisture content.

It can be brought down to a very low iron content, and although it might contain considerable mica, 30-mesh and finer should be satisfactory for their use especially where price and tonnage play such an important part.

There is an almost unlimited quantity of crude feldspar available that can be milled to meet any reasonable specification, where white opaque fusion is not required, and the allowable silica and iron content be over 70% and 1%, respectively.

As stated at the beginning of this contribution, its object is to further the adoption of Standard Specifications or at least to promote helpful discussions of this subject.

The user can be concerned only in securing a suitable feldspar at a reasonable cost and should try to get adopted for his branch of the trade, a set of specifications under which it is practical to produce ground feldspar from the sources available, and by milling methods which are considered practical in a modern way.

Just so long as no Standard Specifications exist, there will be unsatisfactory and un-uniform feldspar produced with a steadily mounting cost to the consumer and possible bankruptcy to the miller.

Adjusting differences between the miller and user is one of the largest items entering into the present cost of producing ground feldspar. Too often does it occur that shipments are refused for no other reason than the shop superintendent's prejudice against the appearance of the raw feldspar. A few simple laboratory tests would indicate that this feldspar was as good as any previously used. Few millers have to date produced feldspar that is always of the same color, fineness, or moisture content.

When feldspar is ground to a definite specification, the manufacturer receiving this feldspar should be obliged to accept at least that shipment without further expense to the producer.

It will be time enough when standards are adopted to improve present milling practice or develop new processes.

By Raymond B. Ladoo:—This paper by Mr. Landers is very timely as it goes to the root of much of the trouble which has been found with commercial feldspar. It is very necessary that both the feldspar producer and the consumer agree upon standards of feldspar for various uses, not only upon grades but upon types of feldspar and fineness of grinding. This subject must be approached, however, with great care for opinions as the needs of individual consumers differ widely. There are also considerable differences in feldspar deposits.

Specifications to be workable and satisfactory to both producers and consumers, must be formed by the joint action of men of wide experience, representing both producers and consumers. Standards set up by only one side or one phase of the industry have often been found unworkable and a source of trouble rather than a help. Wide experience is needed for conditions of production and consumption differ so greatly in different districts that generalizations based on experience in one field only are often dangerous and misleading.

The terms "standards" and "specifications" have been used rather loosely at times with the result that at present they do not always convey the same meaning to different people. Of course absolute standardization of feldspar in the sense that is implied in the standardization of screw threads, of rail sizes and weights, etc., is impossible. Instead an attempt should be made at first to draw up specifications for different uses giving rather wide tolerances. Such specifications might mention the most acceptable fineness of grinding, the total alkali content, the maximum allowable iron content, or whether or not impurities such as tourmaline, hornblende, garnet, pyrite, biotite, etc., shall be tolerated. It would be expected that these specifications would be revised at stated periods improving them and making them more specific as knowledge of production and utilization increases.

The following comments are based on Mr. Landers' paper:

On page 271 it is stated that the common minerals associated with feldspar, for example, quartz, hornblende, tourmaline, etc., "will always be present to a certain degree." While it is true that most pegmatite deposits contain some or even all of the minerals noted it is often the case that these minerals are segregated along the walls or in other portions of a deposit and are not mixed with the massive feldspar. Thus it is sometimes possible to mine feldspar almost entirely free from any visible impurities.

In other cases it is possible to mine large bodies of feldspar which contain only quartz as a visible impurity. Portions of the dike carrying other impurities in such cases are left standing in the mine. Very large quantities of crude commercial feldspar are obtained which are practically free from the objectionable impurities noted.

On page 271, Mr. Landers mentioned "the R minerals, of which garnet is the principal offender." It is not quite clear what is meant by the "R minerals," but I assume reference is made to the complex silicate minerals which contain iron, manganese, and magnesium in varying proportions. While it is true that in some instances garnet is the principal impurity of this type, in other deposits garnet is subordinate or absent and tourmaline is the chief offender. In other cases hornblende or biotite or beryl occur in abundance and render feldspar worthless under present conditions. This is an important point because garnet, on account of its high specific gravity, may perhaps be eliminated by some system of mechanical concentration. Hornblende, tourmaline, beryl and biotite are too close to feldspar in specific gravity to make possible successful gravity concentration.

The problem of determination of free silica is difficult but it cannot be solved by merely determining total silica. The somewhat common practice of using total silica content as an index of the free silica content is incorrect and misleading for the reason that the different feldspars have different alkali-alumina-silica ratios. Pure potash feldspar (microcline and orthoclase) contains theoretically 64.75% SiO_2; pure soda feldspar (albite) 68.8% SiO_2; and pure lime feldspar (anorthite) 43.2% SiO_2. Thus it is possible to have a high total silica content with a low free silica content and it is also possible to have a low total silica content with a fairly high free silica content. Various types of pure feldspar, therefore, *may vary in total silica content all the way from less than 50* per cent to about 69 per cent without containing any free quartz. In actual practice the only method of determining free silica (and this is only approximate) is first to make a complete analysis, and second to calculate from this analysis the mineralogical composition based on the amounts of alkalies and alumina present. The total silica required by each of the feldspars and by kaolin, if present, should be added together and this sum deducted from the total silica as given in the complete analysis. An actual calculation based on this method showed that in two analyses of the same feldspar the difference in total silica was only about 3% whereas by calculation the difference in free silica was about 12 per cent.

In the discussion of the effect of alumina, free alumina must be meant as the alumina in feldspar is a component part of the mineral and in quantity it bears a definite and unchanging ratio to the alkali of the feldspar. Any excess of alumina not required by the alkali present is usually considered

as kaolin (in a feldspar free from mica, garnet, etc.) due to greater or less alteration of feldspar. Sometimes this alteration is not visible to the unaided eye but is plainly visible under a microscope. Thus free alumina is rarely, if ever, present in feldspar. In pure feldspar any variations in the alumina content must mean a proportionate variation in the alkali content.

On page 273, it is stated that it has been impossible to eliminate completely dark specks in fused samples of feldspar when these are examined under a microscope. This is probably true of feldspar which originally contained impurities, but when a pure feldspar is fused black specks can be introduced only by careless handling either in preparing the material or in firing it.

I agree entirely with Mr. Landers' conclusions that iron may get into the feldspar from many sources so that feldspar which is iron free in the quarry may contain considerable iron before it reaches the potter. Precautions must be taken in mining, transporting and milling feldspar in order that iron may not be introduced, and if introduced may be removed during the milling process. However, as noted by Mr. Spurrier in a previous discussion, feldspar which is delivered to the potter in a practically iron free condition may pick up considerable quantities of iron in the pottery. The question of iron, therefore, is one which cannot be settled alone by the feldspar producer but part of the burden must rest on the consumer.

It is stated that mica, either muscovite or biotite, is always present in feldspar. In some districts this is true, but in some deposits in other districts feldspar practically free from mica can be obtained in quantity, in some cases easily and in some cases only by careful mining and sorting. Therefore, mica is not to be considered always as a necessary impurity. It has been commonly assumed that muscovite mica is chemically harmless but this is not always true. Muscovite is a mineral of variable composition; sometimes it may be iron free but in other cases pure muscovite may contain a considerable quantity of iron. Thus one analysis of a typical North Carolina muscovite mica shows about $2^1/_2$ per cent Fe_2O_3. This may be a source of iron which is sometimes unexpectedly found in feldspar. It is stated that mica is practically infusible under conditions met with in the pottery and enamel trades; but Watts[1] states that while muscovite alone fuses at cone 13, fine ground muscovite in potash feldspar lowers the deformation temperature and that the rate of deformation increases with increased proportion of muscovite.

Garnet, as noted previously is not found, at least in large quantities, in all feldspar deposits. Therefore, the problem of elimination of garnet is not common to all feldspar producers. It does not seem necessary to at-

[1] Watts, A. S., "Mining and Treatment of Feldspar and Kaolin," *Bureau of Mines Bulletin*, **53**, page 29.

tempt to define the permissible amount of garnet in feldspar for the color and appearance of fusion test pieces should govern in pottery feldspar, and the total iron content, as shown by analysis, in a feldspar for the glass and enamel trade. It should be possible to set up standards of color for fusion test pieces just as it has been possible to standardize color in white pigments and other materials where a pure white color is essential.

The problem of the separation of tourmaline and hornblende is a serious one and one which has not been solved. The specific gravity of tourmaline varies from 2.98 to 3.20; hornblende 2.9 to 3.4; feldspar 2.44 to 2.8 and garnet 3.15 to 4.38. It is evident that while the differences in specific gravity between feldspar and garnet are sufficient to allow a fairly complete separation by gravity methods the differences in specific gravity between hornblende, tourmaline and feldspar are small and are not sufficient to permit a successful mechanical concentration. The elimination of tourmaline and hornblende must, therefore, await the development of new and better methods of concentration.

On page 276, reference is made to the fine grinding of feldspar and it is stated that it is impossible to produce very fine ground feldspar commercially by the use of screens or air separators "at the present or a reasonably higher cost." While the economical use of screens for this purpose has not yet been definitely proved I think it has been definitely proved in a great many cases that very finely ground materials, not only feldspar but many other materials, can be separated successfully by the various systems of air separation now in use. The use of air separators for the classification of extremely fine ground materials has grown very rapidly within the past few years and the success of such methods cannot be questioned.

The present methods of determining the fineness of feldspar are somewhat unsatisfactory in that a determination of fineness is usually made on but one screen, the 140- or the 150-mesh. Grinding tests on many different types of material including feldspar have shown that two materials may show almost identical results on one screen but still contain very different proportions of extremely fine material. Thus, for example, two materials might show both a residue of only one-half of one per cent on a 140-screen, but one of these might show 50% on a 250-mesh screen while the other might show only 1% on a 250-mesh screen. Therefore, in order to obtain an accurate estimate of the fineness it is necessary to use not only a limiting screen but one or more screens which are much finer, or it is necessary to use some method of elutriation which will determine the relative amounts of grains of the different sizes. This method of determination of size by elutriation is slow and is often not necessary, but it usually gives accurate results on a material like feldspar. Feldspar ordinarily possesses a good cleavage and the shape of grain in fine grinding depends more upon this cleavage than upon the method of grinding. In the case of materials which

do not have a good cleavage the shape of grains is often influenced greatly by the method of grinding. While most present specifications for feldspar are based on a fineness of $99^1/_2\%$ through a 140-mesh screen it is evident that most potters desire a large percentage of very fine material. It is suggested, therefore, that not only the 140-mesh screen be used but in addition the retention on a 300-mesh screen be specified.

It is stated that "a wet-ground feldspar may settle as fast as five times the rate of a dry-ground feldspar and yet both will give identical results on a complete screen analysis." It is important to know in this connection what was the finest screen used in this complete screen analysis and what were the relative amounts which were retained on and which passed through this finest screen. In these tests it is probable that some of the material was in a colloidal state and that the presence or absence of coagulating or settling reagents had more effect on the rate of settling than the absolute fineness. This matter should be investigated further and, if it is found that colloids have an appreciable effect on the rate of settling in feldspar elutriation tests, then any standards based on this method of testing should provide for the reduction of all samples to the same colloidal condition, that is, all samples should be treated either entirely free from settling reagents or should have definite amounts and the same amounts of such reagent present.

It seems probable that for most purposes the determination of fineness can be made best by the use of several screens of which the finest should be 300-mesh (or finer if obtainable).

While it has been demonstrated that very finely ground feldspar can be made commercially by dry grinding and air separation as well as by wet grinding, the relative costs and the relative merits of the two systems have not yet been established. It is conceivable that it will be found in some instances that dry grinding methods will be preferable and cheaper and in other instances wet grinding methods will be more suitable.

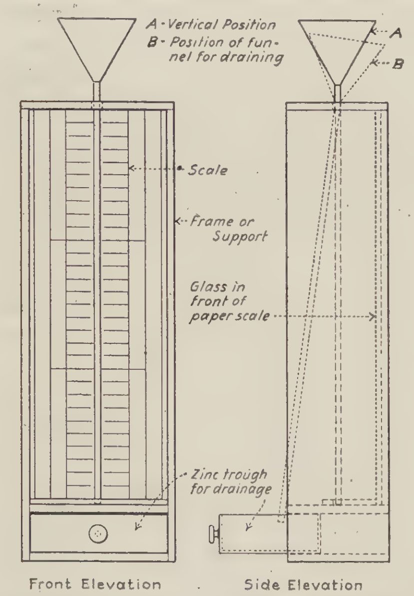
The whole subject of feldspar specifications for various uses should be gone into very carefully by a committee composed of both producers and consumers of feldspar. Mr. Landers' paper has pointed out the need for such work and I am heartily in accord not only with his efforts, but with his major conclusions. It is to be hoped that definite action may be taken on this subject soon.

Method and Apparatus for Quickly Determining Fineness of Grind

By Eric W. Turner:—When such materials as feldspar and flint are ground in the intermittent type of pebble mill, the determination of the finishing point has always contained the element of chance to an appreciable degree.

A mill of a certain length and diameter, revolving at a given speed and containing a certain weight of pebbles, will grind a standard charge of crude material to the required degree of fineness in a certain number of hours.

So long as the physical characteristics of the crude material remain uniform the period of grinding will remain approximately constant. However, should these characteristics fluctuate the period of grinding will vary accordingly. This factor has always been controlled by the man in charge of the operation. For instance, if the crude material is damper than usual he would cause the grinding period to be lengthened out. On the other hand, if the material was dryer than usual the grinding period would be shortened.



Apparatus for Determining Fineness of Grind

FIG. 1.

While the material has been ground supposedly to specification there has been no method for rapidly proving with practical accuracy that such is the case. The method of rubbing between the fingers or of biting it between the teeth is unreliable while the standard screen test is not applicable owing to the length of time each mill would be held up while the test was being made.

A shop test to be practical must be simple, rapid and economical so that it can be performed by the mill foreman without hampering production. In order to fill the want of such a test the following method and apparatus have been devised.

It is assumed in this description that the required degree of fineness is not less than 99% passing through a 160 brass screen of the Tyler testing type.

The cap is first removed from the mill and a suitable quantity of ground material extracted by means of a long handled dipper. From this sample 300 grams are weighed out on a rough pair of gram scales. A set of ordinary spring scales of the household variety is satisfactory. The sample is then transferred in the dry state to the test screen and the fines washed through with a stream of running water. The residue is rubbed with a camel's hair brush to make sure that no fines remain on the screen. The fines are allowed to run away as it is only necessary to determine the per cent of coarse residue. This is determined directly in the simple volumeter which is illustrated (Fig. 1).

This consists of a glass funnel with a long stem, a suitable support and a vertical scale graduated in tenths of a per cent. The end of the stem is closed with a small cork stopper. The only other accessory equipment is a wash bottle. The ordinary laboratory wash bottle has been found to be too light to stand the rough usage it gets in the shop and in place of this a pint milk bottle is used fitted up in the usual manner.

The stem of the funnel is first filled with water and all air bubbles removed by means of a piece of straight wire. This procedure is necessary, otherwise the funnel will become clogged. The residue is then transferred from the screen to the funnel by use of the wash bottle. The residue will pass very rapidly from the cone down into the stem and when settlement is complete the percentage rejection can be read directly from the scale. If this is less than 1% the mill is discharged, if greater than 1% the cap is replaced and the grinding continued. The funnel is easily cleaned out by simply removing the stopper and allowing the material to drain into the pan which is provided for the purpose. The time required to make this test is less than three minutes.

In calibrating the scale it has been found advisable to have the distance between the one-tenth per cent divisions as great as possible to permit of rapid and accurate reading. When the percentages are calculated on the basis of a 300-gram sample the scale divisions are sufficiently large to provide for this and it is for this reason the 300-gram sample is used.

To calibrate the scale, a small quantity of coarse residue is accumulated and dried. From this three grams are accurately weighed out. This quantity then represents 1% of 300 grams. This is placed in the volumeter and allowed to settle for two minutes. The head of the column is then marked off. This height then represents 1%. This is divided into ten equal parts each of which represent one-tenth of one per cent. The scale can then be extended by means of dividers to any desired length or to conform to the length of the stem. When more than one funnel is to be used it will be necessary to calibrate each one separately as the variation in the inside diameters is quite considerable.

With this method no attempt is made to attain scientific accuracy but the results are sufficiently accurate for all practical purposes. Of course the residues from materials whose specific gravities are widely different could not be determined on the same scale but for materials such as flint, feldspar and glaze the results from one scale are accurate enough.

By George M. Darby:—The Dorr Company apparatus would have quite an application in the classification and dewatering of ground feldspar and considerable tests have been carried out at our Westport Mill to determine the sizes of units necessary for such separation and dewatering. We grind the feldspar wet and can easily make a classification at

200-, 300- or 350-mesh. The problem then is to dewater the fine feldspar.

The material is in a finely divided condition and will not settle readily. It is deflocculated, that is, dispersed. To coagulate or flocculate the solids requires some electrolyte.

After a large amount of research we have found that *lime* is the only electrolyte which has an appreciable effect. But the mere mention of the name *lime* to a ceramic engineer condemns its use as a coagulant. The amount we use is very small, an average of 5 pounds lime per ton of feldspar dewatered. The bulk of the lime is removed when the water is decanted, only a very small part of the lime remaining with the feldspar. For example: Assume a feed to a Dorr thickener to be 15 tons water, 1 ton of feldspar and 5 pounds of lime. The feldspar settles to a dilution of .5 to 1 (33% moisture). Then 14.5 tons of water have been decanted, and with it $\frac{14.5}{15} \times 5$ lbs. of lime in solution. Only $^1/_{30}$ of the original 5 lbs. of lime (or .17 lbs.) remains with the feldspar.

Figuring .17 lbs. of lime remaining with the feldspar it gives 0.0085% lime in the feldspar.

By George M. Darby:[1]—I appreciate your letter and "Colloquium on Feldspar." It gives us great satisfaction to have you voice the opinion that the slight additional amount of lime adsorbed from the flocculating agent would not be harmful.

This discussion definitely indicates the lack of uniformity in the prepared feldspar. In batch grinding or open circuit grinding one cannot hope to secure a uniform product. But in closed circuit grinding in which the material which has been ground to the desired fineness is being removed continually, and only the oversize is returned to the mill, a uniform product of a certain size is readily obtainable.

Dry grinding in conjunction with air or screen separation is more expensive than wet operation.

To produce a product finer than 100-, 200- or 300-mesh we would operate a bowl classifier in closed circuit with a tube mill or conical mill (grinding wet). The 100-, 200-mesh or 300-mesh feldspar would be overflowed to a thickener for dewatering (with slight addition of lime to assist flocculation and settling) and the feldspar coarser than 200-mesh or 300-mesh would be returned to the mill along with fresh feed for further grinding. The thickened feldspar would then be dewatered further on a continuous filter, and the filter cake fed to a dryer.

Reply to Mr. Darby by W. H. Landers:—Mr. Darby's comment on the necessity of providing a coagulant if feldspar is to be settled within a

[1] Received July 19, 1922.

reasonable time previous to or during dewatering, is borne out by actual milling operations.

Many careful observations of the action of very finely ground feldspar in water, have caused me to believe that fineness alone does not greatly retard the settling of feldspar, although it is quite apparent that the coarser the feldspar particle, the quicker it will settle.

The feldspar which fails to settle promptly, is not necessarily finer than that which settles within a reasonable period, but it has not been proven that the permanently suspended matter is altogether in a colloidal state.

Chemical analysis of the two materials does not indicate a conclusive difference.

Lime will coagulate all of the visible solids, and acts in other helpful ways during the process of wet grinding.

It cannot be used indiscriminately without causing some mechanical difficulties, but is so far, the best settling agent available.

In actual practice, a far less quantity than 5 pounds of lime per ton of feldspar dewatered, gives the desired result, and many chemical analyses made on both the raw feldspar and the finished product, show no more than a trace of CaO.

This small amount can have no influence on the subsequent use of the ground feldspar, especially when it is realized that many use lime to a more or less degree.

By O. O. Bowman, 2nd:—The subject of "Feldspar and Feldspar Grinding" is a very broad one and one that appeals to me very much. My interest in feldspar began when the matter of getting good, ground feldspar during the war times was practically impossible. Further than that, the price of the material was exceedingly high for the quality received. Therefore, we thought it would be advisable to go into the grinding of feldspar for our own use. I made a trip to Canada, visiting a number of mines in the Verona section of Ontario. Among the mines in this section and one that had the greatest reputation for producing some of the finest feldspar in Canada was the old Richardson Mine.

I was able to obtain enough feldspar for our own use. This feldspar was all bought as strictly No. 1 grade feldspar. All cobbing was to be done at the mines so that the material received at our plant was ready to be ground and no cobbing would be necessary. I was able to obtain a very good grade of feldspar at a price that would allow me to grind the material and have a finished product with a saving of about three to four dollars per ton. Had this feldspar cost me exactly the same as the ground feldspar, I would still feel that I was ahead of the game. The reason for this was that one saw the actual material that was used for the ground feldspar, knew the length of grinding time and could regulate the fineness to re-

quirement. If there was any trouble with the feldspar, it would be one's own fault. Further than that, by buying the crude feldspar, it was possible to carry a six months' supply and we often had as high as three hundred to three hundred and fifty tons of feldspar on the ground.

I must explain that we did not equip ourselves principally to grind feldspar. We already had a unit which was grinding a product for us but this unit was only running on a 50 per cent capacity inasmuch as our supply of the material did not warrant any larger production, so that by grinding feldspar, we cut down our overhead on this unit and the cost on our feldspar and the other material we were grinding. Our unit for grinding consisted of three chaser stones and two two-ton ball mills of Thropp manufacture. By running this unit 50 per cent on feldspar, we were able to produce enough ground feldspar for our daily use and keep a small stock.

As explained above, our method of grinding is not elaborate nor did we change anything for the grinding of feldspar, although I am satisfied that we can very well make a small change and save considerable in our grinding cost, such as by putting in a rock crusher and special conveyors. Our feldspar is first put under chaser stones where it is crushed and put through a $^1/_4''$-mesh screen. The tailings of this are put back under the stones and the product goes directly to ball mills and is ground for seven hours. Our product at end of seven hours gives us a feldspar equal to any feldspar purchased on the market today for fineness and quality.

I have visited a number of grinding plants. In the most efficient equipment, the Hardinge Mill is being used and from the information which I can obtain it is going to replace the intermittent mill in a number of places.

There is a great deal that can be said about the grinding of feldspar and inasmuch as we are not grinders of feldspar, I will leave it to the grinders to write their own discussions. However, the time is coming when the grinders have got to produce the quality and the manufacturer will have to pay the price for good material, but he is going to be willing to pay the price for the material provided he obtains what he is paying for.

By C. R. Moore:—The writer has followed with interest the various discussions on feldspar grinding and having investigated various grinding methods for reducing the material is making the following comments on the colloquium:

The answer to the first question by Mr. V. A. Stout that dry grinding can be performed as cheaply as wet is very reasonable but from a miller's standpoint the dry process has much in its favor. If it is advisable for efficient operation in dry grinding that the material be dry within one per cent of moisture, it is obviously cheaper to remove the 5% or 10% moisture from the incoming feldspar than to remove the 35% or 40% that has to be added for wet grinding.

This statement is based on the fact that the relative efficiency of a grinding unit wet and dry, while probably favoring the wet very slightly would be offset considerably by the increased cost of drying.

The logical method of drying the wet-mill product is by feeding it to a rotary continuous filter and removing as much moisture as possible by vacuum. This type of filter consists of a large wheel four to six feet in diameter and a face of from one to ten feet. The face or perimeter is covered with canvas and the wheel rotates in the slurry up to about one-third its height. Suction applied through pipes inside the wheel removes the moisture, the solids forming a cake on the perimeter which is removed by a scraper as the wheel rotates.

The moisture content of the cake is probably about 15%. This must then be conveyed to a drier for the removal of the remaining moisture. This drier, if of a continuous type which, of course is desirable, is liable to cause iron contamination which is objectionable.

There is a device on the market admirably adapted for this drying which would eliminate this iron. It consists of a woven wire belt mattress of the same width as the face of the filter. This belt rotates with the filter, on its face and the cake is built up in the mesh of the belt. The belt conveys the cake from the filter to the dryer, through which it is carried continuously until it is as dry as required.

The resulting cake is granular and dustless, readily disintegrates and yet is very convenient for handling.

These methods should be of interest to millers on account of this continuous action as compared to the intermittent action of filter presses, but their initial expense is high.

For the potter who produces his own feldspar, wet grinding should be desirable, especially if the incoming feldspar is fairly high in moisture, as drying can be omitted. In this case the finished feldspar can be pumped to agitators and measured wet. The solids per gallon are readily determined from the specific gravity of the slurry and solids. The effect of evaporation is small and can be readily corrected.

The objection to this method is the space required for storage and the constant need of agitation. If this agitation is as slow as possible iron and large grains of feldspar tend to settle and can be periodically removed which is quite an advantage. From the miller's standpoint, however, this method is out of the question on account of the shipping difficulties and to get the finished product in a dry state as cheaply as possible is his problem. Dry grinding, therefore, inasmuch as it omits the expensive drying operations, has much to recommend it to the miller.

In the opinion of the writer the grinding activities of large mining companies cannot be over emphasized in their relation to other grinding problems. The actual grinding of feldspar presents no difficulties that

have not been already surmounted by various mining companies and the results of their work are published freely.

With this fund of information at the disposal of millers it is more or less fool-hardy to duplicate expensive tests that have already been performed on ores similar to feldspar.

It has been proven many times that in a cylindrical tube mill of 22 feet in length, approximately 90% of the material is reduced to the required fineness in the first four or five feet of mill, the other seventeen or eighteen feet being necessary to reduce the remaining 10%. As the power used is in direct proportion to the length it is obvious that three or four times as much power is required to reduce 10% of the material as was needed for 90%.

This is due to the cushioning effect of the already ground material on the pebbles, making it difficult to concentrate a forceful blow on the coarser material.

In the case of batch mills the same action is apparent.

The biggest proportion of the mill charge is reduced to the required fineness in possibly less than a fourth of the total time required for the reducing of the whole charge. This is also because of the cushioning effect of the fine material.

The outcome of these tests has been the closed circuit system of grinding which is now standard in nearly all mining operations.

The mill length has been cut to about a fourth of its former size with a consequent large saving in power and the resulting cost per ton of ground ore is decidedly cheaper than with the old methods of open circuit grinding.

For fine grinding the short cylindrical or conical mills have replaced other types. The chaser mills are almost relics of the past where efficient operation is concerned.

The removal of impurities in the ore is a question of great concern to millers and undoubtedly this is difficult of solution in the case of quartz and mica except by hand packing.

Metallic impurities due to their high specific gravity can be removed by concentrating tables such as are used in mines, but quartz and mica do not lend themselves readily to this method on account of the similarity of their weight to that of feldspar.

There are on the market concentrating tables for both dry and wet processes so that use of a table does not compel one to adopt the wet method of grinding.

The copper sulphite, which Mr. Everett Townsend mentions as being evident in some of his feldspar, could be removed in this manner as also could iron sulphide.

For the benefit of those unfamiliar with concentrating tables a simple description would be of interest.

The wet tables are about 15 ft. long and 6 ft. wide. They are slightly inclined to one corner and receive a rapid vibratory motion in the direction of their length. The feed is at the high corner and due to the vibration the product is spread out over the surface. The heavier materials sink into grooves arranged lengthwise on the table and are discharged at the low end. The lighter materials overflow the grooves and are discharged at the side.

The dry concentrating tables operate on the same principle, except that the feed is made to flow by the introduction of low pressure air through a screen on the top of the table. Another device for dry concentration is the plumb pneumatic jig. This is a small machine 3½ inches wide and 24 to 36 inches long. The feed rests on a screen in a bed about 2 inches deep and this bed is caused to vibrate by pulsations of air from below. The heavier materials sink to the bottom and the lighter overflow at the top. The heavier particles are continuously removed by a simple device on the machine. The writer has had no opportunity of observing these dry machines in action but is of the opinion that they would perform their work satisfactorily and readily remove heavy impurities from feldspar.

Reply to Mr. Moore by W. H. Landers:—Mr. C. R. Moore has made some rather interesting comments on certain feldspar grinding problems. Most feldspar as received by the miller, even if wet by recent rains, does not contain over 2% of moisture. It is necessary to dry this to less than 1% before dry grinding, or more properly speaking, dry pulverizing can be satisfactorily carried on. This can be done mechanically in the case of large tonnages, or under drying sheds, where a comparatively small tonnage is handled daily. One very interesting situation has been noticed recently and that is that the so-called dry ground feldspar seldom contains less than 1% of moisture, and may reach 3% without its dampness being apparent. This added moisture is unquestionably obtained from the humidity of the atmosphere, as it is certain that it comes out of the mechanical dryer with far less than 1%, and yet when sampled in the car 24 hours after milling, has apparently taken up considerable moisture from some source.

A sample thoroughly dried and left on a scale pan over night, shows very definitely increased weight within 12 hours, particularly if the day happens to have been a very humid one. Actual practice demonstrates that from a milling standpoint, wet grinding is in every way preferable to dry grinding, when the former operation is thoroughly understood. Recent tests on a large conical mill gave an average monthly performance of 2.6 tons per hour when grinding dry, from 1-inch size to 50% through 150-mesh, and when grinding wet, a tonnage of over 6 tons per hour was reached without discovering what the ultimate capacity of this particular mill was. This difference would be even greater on the tube mills. It

is a very simple matter to reduce the moisture from wet mill pulp to less than 20% on the very fine sizes, but from that point on, drying is necessary; it can be satisfactorily and continuously performed at a very reasonable cost, and without danger of adding iron to the finished product.

The peculiar nature of the feldspar filter cake, however, very definitely limits the type of dryer to be employed. Wet grinding can best be employed, however, when it is desired to turn out a comparatively large tonnage, to make extremely fine sizes, or to purify the feldspar in process. As Mr. Moore states, the feldspar pulp can be used by the manufacturer in the form of slurry, without previous drying; that is what the British practice.

A method of storing wet pulp without constant agitation is possible and is practically used.

With respect to purification, quartz seems to be the only thing not now being substantially removed where the wet process is used.

By C. M. Franzheim:—I have read with a great deal of interest the various colloquiums and discussions issued this year on the subject of feldspar, and feel as though a great deal of good has been done in this discussion in bringing out the various weaknesses and strong points of the development of feldspar. By which I mean, the proper development of feldspar.

The problem of the preparation of the various grades of flints for the ceramic industry is fundamentally a grinding problem, but the preparation of feldspar for the ceramic industry is fundamentally a mining problem.

In the minds of ninety per cent of the feldspar-using trades they fail to recognize this fundamental fact.

The bulk of the cost of flint of the ordinary kind is in grinding. The bulk of the cost of most all feldspars is in labor, in the selection of the rock and the mining of it. The cost of grinding feldspar is, therefore, much smaller than the cost of the labor of the mining. Flint deposits and feldspar deposits have entirely different characteristics as a general rule.

Of course, were there to be found a feldspar deposit of any large size with practically pure feldspar, then it would be possible, not only to sell this feldspar almost as cheaply as flint, but that particular mine would then be a grinding problem and not a mining problem. Unfortunately, there are no such feldspar mines anywhere, hence all feldspar mines today are in the category of mining problems, and will remain so until such a large pure deposit of feldspar is found.

I have noted also in some of the recent discussions, the suggested advisability of feldspar specifications. We would welcome this, but it would be impossible for any set of specifications to be drawn up to be of any real practical or commercial value. Of course, it is possible to draw up a set

of specifications to suit all cases, but it would have to be so broad in its scope as to be practically valueless in the majority of individual requirements.

The reason why such a specification would not be practical, or have possible value is because of the different characteristics of the feldspar deposits located in the different fields. Unless the specification was general enough to take in all possible feldspar it would then be preferential, and preferential specifications could not possibly be of commercial value to the trades as a whole.

Canadian feldspars have some very fine characteristics for certain trades. Maine feldspars have very fine characteristics for certain trades, and other feldspars all have their own characteristics and may, or may not, be adapted to certain businesses, as the case may be.

The fact that a particular feldspar has a higher potash content, or a higher alkali content than some other feldspar does not mean that feldspar is far more valuable. It may be quite the reverse. It is the proper balance of the feldspar which counts and makes it valuable. Because of the high alkali contents of any feldspar the alumina content has such a bearing in helping maintain the balance that all the good of high potash may be lost by high alumina. Or, all the good of high potash and properly balanced alumina may be lost by black mica, high quartz or poor color. Feldspar mines which are operating today on a commercial basis may be inactive within the next ten years because even mines change or exhaust themselves. How then can specifications be drawn up for feldspar in a general way when specifications do not take into consideration, or cannot possibly do so, the very principal element of feldspar, namely its uniformity and constancy from year to year. This is the most difficult problem of feldspar producers in conjunction with careful mining. A feldspar which is properly balanced, and will only run uniform for a period of two or three months, although conforming to all specifications, is not a proper feldspar on a commercial basis, and the great value of feldspar is its uniformity from car to car, from month to month, and year to year, and any plant can become accustomed to any feldspar, regardless of specifications, provided that feldspar comes uniform from year to year. It is just as wrong for a feldspar producer to suddenly ship a pottery a car or two of excellent feldspar, much better than the last two cars, than it is to ship them feldspar which would be inferior to the last two cars, and greater loss on any pottery can be entailed by suddenly improving the quality of the feldspar without notice to them than a sudden lessening of the quality. If feldspar cannot be produced not only uniformly from month to month, but from year to year, then that feldspar is not a commercial grade. After all the uniformity of feldspar from year to year determines its real value, regardless of black speck, of potash content and of any other feature,

even price. Of course, all those items have some bearing, but in the end uniformity of the product is seventy per cent of the battle.

Naturally a feldspar producer does not want any more black speck, due to black mica or other foreign substance, in the feldspar than does the user, but he is required to accept the deposits as laid down by Providence, and there is not a commercial feldspar mine anywhere which does not contain these foreign substances. When one buys oranges he gets seeds, although it is possible to buy oranges without seeds. But as a rule, the oranges without seeds do not have the juice, and it is the juice that we are after. Is it not cheaper and best to buy oranges with the seeds and remove them, thus securing the greatest volume of juice? Of course, there are sometimes exceptions, and so are there exceptions with feldspar, but feldspar specifications which say there shall be no black speck are of no value because there is not one feldspar producer who can honestly fulfill same. And usually these exceptions are not feldspar offerings on a standard commercial basis.

Reply to Mr. Franzheim by W. H. Landers:—Mr. C. M. Franzheim's claim that the preparation of feldspar for the ceramic industry, is fundamentally a mining problem is quite justified, but there is no reason why the preparation of flints should not also be so classified. The greater proportion of flint used, and the consequent demand for a lower price has no doubt had some influence in getting the consumer to accept such flint as is offered without subjecting it to the critical discrimination with which he judges feldspar or other materials which appear on the surface of the finished ware.

The various clays appear as the result of a mining problem which the clay producer will insist is no less important than that of the feldspar miner.

The truth is that none of the rock products entering into the ceramic industry occur in such a pure state and in such large bodies that they have only to be considered from the "preparation for market" standpoint. Feldspar, as stated before, appearing as a finished material, and therefore subject to the scrutiny of the consumer, has come in for an amount of unjust criticism, and too much has been blamed on the feldspar, when the guilt should be shared by the other elements present.

It must not be overlooked that in England, a considerable quantity of material doing similar duty to our spar, is nothing more nor less than granite ground in water, and delivered wet in tank wagons to the potters and other users They get away with it, and succeed in turning out some very high grade porcelain ware.

They seem to be somewhat more critical of their clays. In this country, up to the present time, we have been skimming the cream so to speak, from extraordinarily pure and favorably located feldspar deposits, and it is

only as these are being mined out, that dissatisfaction has appeared in the ranks of the users of feldspar.

When it is desired to make any high grade finished product one of the prime requisites is to start with the best raw material obtainable.

The amount of impurities present in the crude, while being substantially reduced by subsequent operations, can seldom be completely eliminated.

It remains therefore, to establish as many standard specifications as possible, to enable both the miner and grinder of feldspar, to set a mark to shoot at; without these there can be no real advance towards improving or making more uniform, the quality of spar turned out by the grinders. Certain natural characteristics such as high or low fusing points, amount of alumina present or the ratios of the two alkalis, will always make feldspars from certain districts differ from those from other districts, and the time will probably never be reached, when the manufacturer can buy feldspar indiscriminately, with as little concern as he now buys gasoline to run his automobile. He may expect and demand uniform results from feldspars produced in each district. This will come more from improved milling and purification methods, than it will from the unsatisfactory and costly selective mining methods now so generally practiced.

When it is realized that most of the objectionable impurities, with the exception of quartz, are present in only small fractions of a per cent, even in the granites or very low grade spars the question of milling or the preparation of a satisfactory product for market, cannot help but become of prime importance. So-called second grade feldspars can be made into a very satisfactory, high grade product by methods now available, but it will be necessary to have certain standards established before these improvements can be generally adopted. Mr. Franzheim stresses the importance of uniformity, but he must realize that there can be little hope of uniformity, so long as the present milling practices are indulged in. Old customs die hard, and competition is their most ruthless destroyer.

GLASS INDUSTRY IN INDIA[1]

By G. P. Ogale

The word "kanch" (glass) is found mentioned very often in old Sanskrit literature during the last two thousand years, signifying the knowledge of glass-making among the ancient Hindus, although adequate records are not available as regards its manufacture, nor have ancient samples and relics been systematically preserved. Glazed tiles were used for flooring and wall decorations even in the twelfth and thirteenth centuries and samples of this kind of work can be seen on buildings of that period. The manufacture of glass bangles (bracelets) and beads was practiced in very ancient

[1] Received March 10, 1921.

times and the authentic existence of these can be traced as far back as the last six hundred years. These were made in the province of Agra and Oudh in the north, in the province of Gujrat and in a few places in the south.

The glass was melted in small clay pots on wood or charcoal fire, and the bangles were made by gathering a small quantity of glass at the end of a small steel rod, and turning the rod by hand and expanding the soft bead of glass into a ring, which was afterwards placed on a clay cone and further expanded to proper size. Even today the demand for these bangles is met by a system of indigenous household industry. Every Indian woman wears at least two or three bangles round her wrist and these form a necessary ornament of a married woman.

There are at present many factories in India on modern scale, turning out hundreds of tons of colored glass in order to supply the demand of the bangle makers, who buy it in the form of cakes or blocks and remelt it in their small furnaces and make bangles. Formerly these people made their own glass, but now prefer to buy it from factories. The household industry also produces small vials, lamps and perfume bottles, but these are very inferior in quality.

Glass factories on modern scale date back only to the last fifty years or so. They were organized with Indian capital but were generally managed by Austrian or German experts. The history of these factories has been one of continuous struggle against various difficulties. The greatest difficulty was to get proper technical help. The training of local labor also had to be arranged for. The so-called experts were in some cases mere adventurers, who worked only during the construction of the factory and bade good-bye even before starting work. Another man who was recruited in his place probably condemned the work done by his predecessors and construction had to be substantially altered.

The experts were not generally willing to train Indian workmen, and in some cases, where they were willing, the proprietors of the factory would not stand the expense of training the labor and waiting until it started paying back. The people who put in their money invested it more from patriotic enthusiasm than from a purely business motive. The lack of technical knowledge on the part of the promoters was a standing obstacle in the progress of the factories and the industry in general.

Then again, the high temperature during the summer months caused many of the European experts to quit their jobs and no adequate arrangement of cooling by artificial means was adopted in any factory. This caused slackness even among the Indian workmen and plants had to be shut down during the hot season.

If Indian works could adopt the air circulation system as is used in this country, the factories could be worked all the year round.

One great cause of the failure in all these factories was the want of government protection or direct help, especially in the beginning, against outside competition. India, owing to her peculiar political situation, has been unfortunately a dumping ground for foreign manufactured goods and unless a system or protective tariff is devised to safeguard industries within her own borders, she will continue to be the happy hunting ground of foreign adventurers to her own detriment.

To fight certain of the causes, the public made an attempt in a new direction. They raised a fund called a "penny fund" and opened a glass school at Talegaon near Bombay about fifteen years ago. The management of this school was placed in the hands of Mr. Ishwardas Varshnei, who had gained his experience in the United States and in Japan. He started with a small direct-fired pot-furnace with the help of Japanese blowers, and took a few Hindu boys for training as blowers. In a few years a good number of hands were trained as blowers, and the plan worked quite well—so much so that the boys are now running the school factory on a profitable basis, while Mr. Varshnei is running three or four factories in the Punjab. He is now trying to put his factories on a most up-to-date scale and is soon to add a window-glass plant to his list. A dozen other factories have been started by the students of the Talegaon school, and are making a steady progress.

The goods turned out at present in the Indian factories are lamp chimneys and globes, tumblers, pressed-ware and bottles. No doubt, the factories working at present are on a small scale and do not supply even a tenth of the demand. Yet they have inspired confidence among the capitalists and big plants are soon to be expected on most modern lines.

Though India abounds in raw materials for the glass industry, these have not as yet been properly investigated. There are good sand deposits in the north, in Gujrat and in the Mysore and Madras presidency. Besides there is plenty of soft sandstone and quartz distributed all over. There is a suitable supply of limestone also well distributed. India produces the largest quantities of manganese in the world. Nitre is produced in the United Provinces. Soda, from the Reh deposits and also from the lakes in Rajputana and Central Provinces is awaiting investigation. At present English soda is largely used. The fuel used is bituminous coal from Bengal and the Central Provinces. Wood is used in two or three factories.

India imports about eight million dollars worth of glass every year from various countries such as England, France, Belgium, Germany, Austria, Japan and the United States. Before the war Austria Hungary ranked first on account of its sales of glass bangles and also took a prominent part in the trade of lamp chimneys. Among exports from Germany were bottles, lamp glasses, and false pearls. The United Kingdom monopolized

the trade in soda bottles and also exported in large quantities bottles and vials, sheet and plate glass and tableware.

The supplies from Belgium consisted of lamp chimneys, pressed tumblers and window-glass.

Japan today holds a very prominent position in her exports of glass to India and has generally taken the place of Germany, Austria and Belgium during war time and is trying to maintain her predominance in the market. The quality of Japanese goods is improving remarkably and Japan has her own methods of underselling.

Owing to the more extended use of glass, the imports of glass in India are constantly increasing in spite of the local manufacture.

OGALE GLASS WORKS, LTD.
OGALWADI OUNDH STATE
DIST. STARA, INDIA

DISCUSSION[1] ON "THE PRODUCTS OF THE CALCINATION OF FLINT AND CHALCEDONY"[2]

BY C. N. FENNER:—In the September number of this *Journal* Washburn and Navias present the results of their study of flint and chalcedony. I should like to offer some discussion of certain parts of their conclusions. These parts are embraced in the following summary of their views (page 581): "(1) Flint and chalcedony consist of colloidal quartz. In the purer forms of chalcedony the colloid is of the gel type and the individual colloidal particles are microscopic or sub-microscopic in size. Fenner found that when chalcedony was heated in contact with a flux at 800°, 'quartz' and tridymite were produced. The 'quartz,' *i. e.*, macrocrystalline quartz, is evidently the result of the recrystallization of the colloidal crystals, and quartz is, of course, the stable form at this temperature. The simultaneous appearance of the metastable tridymite under such conditions is a common phenomenon..... (4) Fenner made a thermal analysis of raw chalcedony over the quartz α-β inversion temperature and failed to find any heat effect indicating an inversion at this temperature. It was largely because of this negative result that he concluded that chalcedony could not be classified as quartz. Now it is altogether probable that both the inversion temperature and the heat of inversion of a quartz crystal vary markedly with the size of the crystal, for crystals of colloidal dimensions. Consequently, according to our theory of the nature of raw chalcedony, we might expect that the quartz inversion would be spread over a considerable range of temperature owing to the varying sizes of particles present, and this inversion might, therefore, easily fail to be detected by the method of thermal analysis."

[1] Recd. Sept. 16, 1922.

[2] Washburn and Navias, *Jour. Amer. Ceram. Soc.*, **5**, 565(1922).

In this explanation the idea of colloidal quartz plays an important part; in fact, the whole theory may be said to rest upon it. By this term I understand that what is meant is silica particles in each of which the atoms are oriented according to the crystal pattern of quartz, but of such minute dimensions individually that surface forces play an important rôle with regard to their environment, and their free energy is thereby considerably increased.

Now I have no objection to offer on theoretical grounds to the idea that quartz particles might be reduced mechanically to such an extreme state of fineness, or might under some circumstances be formed that way in nature, but I think there might be room for question as to whether the natural deposition of quartz from solution in such minute particles under the conditions that give rise to chalcedony, would be probable. This phase of the question, however, is one on which I would bear very lightly because definite data are lacking; but there is another on which one may speak with more confidence. Chalcedony is not a satisfactory material for microscopic study, but that is largely due to its fibers intermeshing in such a way that aggregate optical effects are likely to be obtained. The individual fibers are rather small units, but usually large enough so that the optical character of their elongation may be obtained, and I should suppose that there is a world of difference between units of this size and those approaching molecular dimensions, where surface forces would be an important factor.

The explanation of Washburn and Navias would require that the grains of their colloidal quartz should be so infinitesimal that its free energy would be greater than that of tridymite, for evidently that is the basis of their explanation of the appearance of tridymite in those experiments of mine in which chalcedony was heated with sodium tungstate at 800°. They say that "*the appearance of the metastable tridymite under such conditions is a common phenomenon.*" I should be glad to have examples of this given, as I am not familiar with anything that seems closely comparable.

The foregoing remarks indicate the points of their theory that seem to me not entirely convincing. On the other hand, the evidence supplied by the X-ray crystal spectra that they reproduce seems to show quite definitely that the material they worked with contained quartz. There are two possibilities that occur to me by which the apparently conflicting evidence might be harmonized.[1] One of these is implied in the paper to which Washburn and Navias have made reference.[2] There I suggest that chalcedony may be a mixture of quartz and some other form of silica

[1] There is nothing essentially new in either of these suggestions.

[2] C. N. Fenner, "The Stability Relations of the Silica Minerals," *Am. J. Sci.*, 36, p. 380.

(presumably amorphous silica). The presence of the amorphous silica would account for the formation of tridymite at 800°, and would tend to blur the evidence of the α-β inversion so that it might not be recognizable. The objection I have felt to this explanation is that it implies the presence of such an amount of amorphous silica that, as I thought, it should have been recognizable microscopically, but I am open to conviction on this point.[1]

The second possibility is that one sample of chalcedony may differ from another in its constitution, and that the superficial resemblance is misleading. In that case different investigators may have worked on different substances. Some basis for this idea may be supposed to be found in the existence of the various similar substances known as quartzine, lutecine, and lussatite which have been described.[2]

The essence of the foregoing may be stated in a few words. Washburn and Navias have presented evidence to show that some chalcedony at least contains crystalline quartz, and this is a distinct contribution to our knowledge of the subject, but the theory of colloidal crystals that they offer in order to bring this into harmony with apparently contradictory results obtained by others does not seem altogether satisfactory, and further evidence is desirable before the problem can be considered settled.

Geophysical Laboratory
Carnegie Institution of Washington
Sept. 12, 1922

Reply by E. W. Washburn:[3]—Dr. Fenner's viewpoint regarding the constitution of chalcedony is not essentially different from the one proposed by us. He suggests that the chalcedony, in addition to containing very small quartz crystals, also may contain amorphous silica. According to our theory of the colloidal constitution of the mineral, it would be formed by the deposition of colloidal quartz made up of exceedingly small crystals of varying sizes. The smaller of these crystals would probably be somewhat ill-formed and would shade off gradually into a material in which the crystalline form was so ill-defined that it might be more properly called amorphous, so that we would have all gradations from some particles practically lacking in crystalline form up through ill-formed crystalline particles to larger and more perfectly formed quartz crystals.

Our remark in citing the appearance of tridymite as an example of a common phenomenon referred merely to the well-known frequent appearance of a metastable phase from a solution saturated with respect to a more stable phase. A solution saturated with respect to quartz, such as

[1] With regard to the possible existence of such a mixture, see H. Leitmeier in article "Chalcedon" in Doelter's Handbuch der Chemie, Bd. 2, erst Hälfte, page 166.

[2] H. Leitmeier, *loc. cit.*, page 165.

[3] Received Sept. 27, 1922.

the one obtained in Dr. Fenner's experiment at 800°, might also be saturated with respect to tridymite. As Dr. Fenner points out, this would of course, necessitate that some of the colloidal particles of the chalcedony would have to be small enough so that they would have a greater free energy than macroscopic tridymite crystals.

As suggested in our paper, it would be interesting to determine the volume change of chalcedony over the quartz α-β inversion temperature. This might give some indication of the amount of crystalline quartz present in the mineral, although here again the volume change on inversion might be expected to vary somewhat with the size of the crystal. For such an experiment it would be necessary first to dry the chalcedony in vacuo at a temperature below that at which inversion could occur.

DISCUSSION ON "NOTES ON SHIVERING OF TERRA COTTA"[1]

E. C. HILL:—I should like to ask Mr. Carruthers, whether he found increased shivering on aging or weathering of these trials. It is well established that crazing increases on weathering, but I have not noticed any further development of shivering on weathering.

In a series of trials I made, using various clays and grog, shivering developed on one trial of a Georgia kaolin body. The same series included a very sandy clay, which developed crazing. From Mr. Carruthers' results, we should expect the sandy clay to develop shivering instead of crazing. The shivering on the Georgia kaolin body might be a form of "peeling," however, since this body is very porous.

MR. CARRUTHERS:—Our experience with shivering has led us to believe that its tendency is always present under certain conditions. Lines of strain will show in ware taken hot from the kiln which will open up later. These lines show where shivering has taken place in the kiln. We have had a number of shivered samples out on the roof of the plant for four years and on which the shivering has not increased.

MR. HOTTINGER:—I wish to call to your attention the fact that in the use of fine silica, the finer you grind the silica the more of it your glaze will take. That is shown very clearly in Mr. Carruther's exhibit. Shivering will be found with the fine silica while with the same content of silica, but coarse, the tendency to shiver will be less.

You might say that the fine silica dissolved by the glaze changes its coefficient causing shivering, whereas with the Georgia clay which is free from silica you have just the opposite. That is, the glaze dissolves clay substance very slowly and if the glaze was not absolutely fitted to the body, the body being very weak, you would be liable to run into shivering. I think that is one explanation, possibly, of the point that you brought out.

[1] J. L. Carruthers, *Jour. Amer. Ceram. Soc.*, **5**, 518 (1922).

Mr. C. W. Hill:—Mr. Carruthers' paper contains many interesting points which doubtless will be of value to others in suggesting the direction in which to go in correcting trouble from shivering. Since the bodies and glazes used by different manufacturers differ widely in properties it is probably unsafe to generalize on the results obtained with specific bodies and a single glaze. Mr. Carruthers very wisely qualifies many statements as referring to his particular conditions.

It is perhaps indicative of the present state of knowledge and methods that this paper like many others deals largely in qualitative tests. It would seem desirable for all of us to attempt to work down to fundamentals. There is, of course, a physical basis for the phenomena observed. Shivering is usually attributed to difference in thermal expansion of the body and the glaze ("poor fit"). Assuming this to be the case it would make such investigations more valuable from a general standpoint if the changes in composition were tied up with determined changes in physical properties such as the coefficient of expansion. With the Bureau of Standards equipped to handle such tests it would seem a comparatively simple matter to secure such data. The science of our industry can be advanced more rapidly by more rigorous methods in our research and as a Society we should, I think, urge upon all contributors to our Journals the necessity for more quantitative physical data along with the qualitative practical tests.

Mr. Carruthers' data would doubtless be of more value to others if he had included the results of common tests generally in use on the clays and bodies (*e. g.*, *clays*—dry and burned shrinkage, porosity, mechanical analysis, *bodies*—absorption, density, coefficient of expansion).

It is doubtful whether it is correct to include under shivering the result of incorrect glaze fit and that of poor tenacity resulting from soluble salts. In many cases it is possible to differentiate between the two effects by observation, one being termed shivering and the other glaze peeling.

Mr. Carruthers' figures on the effect of addition of soluble salts are difficult of interpretation since the amount and kind of soluble salts already in the body are not given. The total amount of salt required to give peeling would be valuable information.

The use of felsite commercially is very interesting from a practical standpoint as well as from its connection with the work of others on fluxes in terra cotta bodies. It is unfortunate again that Mr. Carruthers has been content to let his investigation rest with the qualitative results. Mr. Carruthers questions whether the felsite has an effect on expansion but does not test the point. Obviously if our usual explanation of shivering is correct it must change the expansion. This should be determined as it is the most valuable point in the whole matter. Having determined that the expansion is changed by the flux it is also very important to know how this is effected. From the miscroscopic examination of Body 6

(Table V) the indication is that the felsite does not attack the free silica but forms a bond around the quartz grains. The effect of felsite on other properties than expansion should also be stated such as green and burned shrinkage, density and porosity.

Mr. Carruthers deals with a subject of general interest and touches on many important points. Anyone in commercial work can understand the difficulties which prevent the complete investigation of a subject and which often result in the reporting of an investigation more as a specific factory problem than as a piece of fundamental research permitting general application. It is to be hoped that as time permits Mr. Carruthers will fill out the work with the tests and data indicated and thus make a noteworthy contribution to the literature of our industry.

Mr. Carruthers:—As Mr. Hottinger and Mr. C. W. Hill have both stated, shivering is purely a local trouble, due to the body and glaze not being properly fitted together. However, we have had the body and glazes properly fitted and then almost over night, shivering would occur This we have traced to the action of excess fine silica occurring in the clay or grog. This change in the body composition will take place without any physical difference being noted in the raw body.

For a number of years, the method of overcoming the trouble, was to fit the glazes to the changed body. Now, we find it more practical to fit the body to the glazes. This is accomplished by the use of a flux such as felsite. It has made the body more safe, *i. e.*, variations in the amount of silica present in the clay or grog are taken care of and shivering troubles eliminated.

DISCUSSION[1] ON "DATA ON VISCOSITY OF INDIANA CLAY SLIP WITH ELECTROLYTES IN REGARD TO THE CASTING OF TERRA COTTA"[2]

By R. L. Clare:—Casting of terra cotta appears to be a logical method of forming small pieces of intricate, or highly ornamented shapes. This includes balusters, rosettes, small gargoyles, small brackets and other small ornamental pieces. Pieces, such as these, do not necessarily have to have a thick wall and their shape lends itself to casting. Pieces such as these also are difficult to press without making them nearly solid, and consequently they are much more liable to spalling, cracking, etc. The splitting of balusters where they are joined would also be eliminated by casting.

Large material, such as ashlar pieces, or other running pieces requiring partitions and thicker surfaces, do not lend themselves quite so readily to

[1] Received Sept. 21, 1922.

[2] H. E. Davis, *Jour. Amer. Ceram. Soc.*, 5, 702 (1922).

casting, and the question of speed of production, cost of moulds, etc., makes it questionable as to its economic possibility.

The difficulties we encountered in casting were that the changes in the clay made it necessary for us to change the proportion of electrolyte constantly, and that a proper electrolyte for the clay one month was not satisfactory the next. This we attributed to a difference in the soluble salts in the clays received. We used both sodium carbonate and sodium silicate and found that a mixture of the two gave the best results.

DISCUSSION ON "AN ACCOUNT OF AN INVESTIGATION OF SOME GEORGIA CLAYS AND BAUXITES"[1]

By W. C. Woodall:—May I say a word of sincere appreciation of the enterprise and friendly interest of *The Journal of the American Ceramic Society* in publishing in its September issue the clear and comprehensive article by Messrs. Gilmore and Fessler relative to the tests of Georgia clays now being made at the Ceramic Station at Columbus, Ohio. The article bears evidence of thorough investigation of this subject, and the publicity thus given this phase of industry in Georgia will beyond doubt hasten the development of the clay and bauxite deposits in the state.

Vast as are the clay deposits of Georgia, the ignorance that has prevailed regarding the ceramic possibilities of this tremendous mass of material, its availability as pottery material and as refractories, has been almost as vast. Today, the first thorough investigation of this material, the first complete, scientific test, is being made. It is interesting to note that this important step was taken at the instance of a progressive railway company which believes in intelligent coöperative effort in the development of the country it serves.

The Central of Georgia Railway, having the largest Georgia mileage of any railroad system has keen realization of the responsibility that this entails and has taken active part in state development work.

Under these conditions, an authoritative investigation of one of the state's greatest natural resources, and its possibilities for refinement and utilization is peculiarly timely. It is the earnest desire of Georgians to witness the development to utilize to the fullest extent the resources of their state by capital from abroad. With the middle belt of the state practically a clay bed, a source of tremendous wealth—an industry that will provide employment for many thousands, that will give capital to another safe and profitable field of development—is indicated. The clay industry should become one of the chief enterprises of Georgia.

The Industrial Index
Columbus, Ga

[1] Gilmore and Fessler, *Jour. Amer. Ceram. Soc.* (*Bull*)., **5**, 193 (1922).

DISCUSSION ON "WET PROCESS ENAMELS FOR CAST IRON"[1]

By J. E. Hansen:[2]—This paper is an especially valuable contribution both to the literature and to the enameling industry, not only because of the fact that it is the first contribution of its kind, but because of the extensive scope of the investigation reported. However, to justify the excellent results obtained by other wet process enamels already in use on cast iron, and not to lead to misapprehensions on the part of future investigators, it should be borne in mind that some of the conclusions reached are true only on enamels of the particular type under discussion and may not apply to all types; for instance, the limit as given for sodium oxide in a sintered ground coat may safely be exceeded in a ground coat of the melted type. Also it is known that certain types of a melted ground coat, with suitable mill additions, are highly successful and may give even greater strength and adherence than those of the sintered type.

The observations and experience of the writer check in general the statements of the authors of this paper. It has clearly been the experience of the writer that the fusion point of ground coats and cover enamels should bear a close relation to each other, and that, if the composition is correct, the cover enamel can be burned at the same temperature or even a slightly higher temperature than the ground coat.

The writer believes that many cases of pinholing in cover enamels can be traced to the lack of such a close relationship in the fusion points of the respective coats and to overburning of the cover enamel.

The writer does not, however, agree with the authors, in their statement that the crawling of high boric oxide enamels is due to the higher viscosity imparted by an excessive amount of that oxide, but believes rather that it is due to the dissolved salts of boric acid which, crystallized from the aqueous suspension of the frit, give up their water of crystallization as the enamel is fired, and by their swelling cause crawling.

The crawling of enamels high in cryolite may possibly be explained by the high viscosity and high surface tension of enamels rich in aluminum compounds, in this case aluminum fluoride. The same effect can be developed in an enamel to which a large amount of aluminum oxide or hydrate is added.

The writer believes that while the enamel composition is undoubtedly of greatest importance, almost as significant factors in the successful enameling of cast iron by the wet process are the manipulation of the enamel and the nature of the cast iron to be enameled.

By W. C. Lindemann:[3]—In checking over the work done by Mr. R. R.

[1] Danielson and Reinecker, *Jour. Amer. Ceram. Soc.*, **5**, 647 (1922).

[2] Sept. 8, 1922.

[3] Recd. September 16, 1922.

Danielson on wet cast iron enamel, all such enamels both in ground coat and cover coat that seem practicable, were tried out on a commercial basis in our enameling plant. The enamels were smelted in commercial batches and the ground coats were fritted, the batches for cover coat being 450 lbs. to a smelt, and the ground coat batches fritted were 125 lbs. to a batch. They were then milled in the usual mill batches varying from 100 to 250 lbs. to a mill. Mill additions were made as shown in the formulas submitted by Mr. Danielson.

The results in general checked the results shown in the laboratory. However, in using the wet cast iron enamel, the actual operation of coating and burning a piece, is of such importance that absolute information cannot be given on any trials until all the operators have been accustomed to the use of any one particular enamel. In this respect, the checking up of one batch of smelted enamel is hardly sufficient to give a definite check on laboratory results although if the results are very bad, one batch is sufficient to show whether the enamel is commercially practicable or not. When the enamel is nearly right, small defects as may appear cannot be attributed directly either to the enamel or the operation, and indefinite results are obtained.

However, in the trials such enamels as proved very bad were immediately dropped from consideration and such other enamels as proved fair were retried on further smelts until a reasonably accurate decision could be given on the same.

The results obtained do not entirely check with the summary given by Mr. Danielson. The ground coats that gave the best results were as follow in the order named: Rg 7, Rg 1 and Rg 26. Ground coats Rg 17, 25 and 18 as mentioned by Mr. Danielson were not practicable on continuous use causing various defects in the final enamel which could not be overcome. On the other hand, Mr. Danielson does not mention Rg 7, which seemed to give uniformly good results on all trials.

Regarding the cover coat, the results show that R1 seemed to be the best for general purposes with R14 and R11 as reasonably good enamels. However, R 28 and R18 as mentioned did not give satisfactory results, R 28 not having sufficient covering capacity and R18 being the same way. Both R 28 and R18 if covered heavily, would cause crawling to such an extent that the pieces would be unusable.

There is a very marked difference in using certain cover coats for certain ground coats and this is especially noticeable on wet cast iron work.

The ground coats and cover coats given above, all seem to work reasonably well together using any one of the ground coats with any one of the cover coats, but the best combination seemed to be as a final checkup, the use of Rg 7 as a ground coat with R1 as a finish coat. However, precaution was necessary on the use of these enamels since the Rg 7 was

rather sensitive on firing and if over-burnt caused cracking in the finish enamel and when under-fired, caused blistering. However, if this ground coat was burnt properly, good results could be uniformly expected. In addition, when using Rg 7 as a ground coat, there were less black spots appeared in the white or finish coat than on any other enamels tried in the entire series. This is an important item since there are very few enamels in wet cast iron work when using a white finish coat where black spots are not noticeable.

By M. E. Manson:—Probably every enameler who reads Messrs. Danielson and Reinecker's paper will find that at certain points their findings are radically different from his own experience. Near the end of the paper, the authors state:

> The fact that cryolite had vastly different effects in the two different types of basic enamels, shows rather definitely that a broad statement cannot be made as to its effect in different types of composition.

I believe that this statement could be enlarged to include not only cryolite, but every ingredient of the enamel.

To the sanitary ware manufacturer, using the dry process of enameling, wet enameling is apt to be of merely academic interest. Nevertheless he has many small pieces, which it would be entirely possible to enamel by the wet process at a great financial saving.

At our plant here we have done a small amount of experimental work on this subject, which has in some features borne out Mr. Danielson's work and in others has not. We found that the degree of smelting the ground coat was of great importance. I even know of one formula, which when mixed raw in a mill, gave very good results. When sintered, and ground, and covered with the same cover coat, it blistered badly. With the particular ground coat which was the basis of most of our experiments, we found that the addition of 15 to 20% of clay in the mill gave best results. Our greatest trouble with this series was blistering of the cover coat. By adding 20% of clay in the mill, and softening the frit accordingly, we did away with the blisters, but the cover enamel was still full of what Danielson calls "incipient pinholes." They look like skin pores, and are present in nearly every piece of wet enameled cast iron I have ever seen.

The further modification of this formula, by reducing lead oxide from 8 to 3% and raising borax proportionately, gave us a successful wet enamel. Test pieces made from this were uniformly good, with very few pores. A hundred pound batch, used on regular factory pieces was fairly successful, but required very careful burning. This substitution of borax for lead oxide had exactly the opposite effect from that observed by Mr. Danielson.

There are many factors affecting a wet enamel besides the enamel composition. A ground coat which will give good results when burned at 1500 degrees will be a failure at 1700 degrees. If the pieces to be enameled will not warp at 1700 degrees an enamel should be developed which will work at that temperature, for production will be higher.

The composition of the iron is an important factor. Formulas which give good results at one foundry, will frequently give miserable results on iron from another foundry.

Still another factor is the thickness of the ground coat. Our ground coat for dry enameling is applied in a very thin coat. I have seen wet enamelers apply what they considered a thin ground, which was nearly twice as thick as ours. It sometimes happens that a ground coat can be made to give much better results if a thinner coating is used.

The above observations are from the small amount of work done here on this subject. As I said before, a good wet enamel was not of such vital interest to us. The most surprising thing in our whole series of experiments was the result we obtained with our own dry process enamel. We used our regular ground coat. We took our regular white coat, ground it with water, 6% clay, and 8% tin oxide, and used it as a cover, and this gave us the best results we have had. This may be only an exceptional case. Nevertheless I would like to know what results could be obtained by the other sanitary ware enamelers, using their composition as a wet enamel.

This whole subject, in spite of the rapid progress it has made is still in its infancy, with much work remaining to be done. Mr. Danielson's excellent paper, however, goes a long way toward the goal of a good wet enamel for cast iron.

Reply to Mr. Hansen by Mr. Danielson:—While we have recommended the "sintering" of all ground coats in this investigation, this is not to be interpreted as meaning that all compositions are of the usual sintered type, that is having a dull refractory finish when fired on the casting. The majority of the ground coats can be fired to a semi-glassy finish. However, we have found that the sintering method results in ground coats possessing more satisfactory adherence to the castings. Almost invariably adherence has been improved by the undersmelting of the ground coat.

We are inclined to disagree with Mr. Hansen that the crawling of the enamels high in boric oxide is due to the dissolved salts of boric acid rather than to the viscosity imparted by excess boric oxide. Enamels of this type are very viscous even in the smelting and the same phenomenon has been noted in enamels for sheet steel. While the soluble salts may tend to cause cracking in extreme cases, we cannot believe that this action alone

would cause crawling on enamels fired as slowly as the enamels applied on castings.

Reply to Mr. Manson by Mr. Danielson:—The various factors aside from enamel composition mentioned by Mr. Manson undoubtedly have an important bearing on the results to be obtained with enamels of the wet process type, but the same conditions are encountered in practically any type of enameling. As a result of our experiments we question, however, whether enamels maturing at 1700°F are practicable for wet process enameling on cast iron. At this temperature we believe there would be a tendency for the surface of the enamel to gloss over in the early stages of the firing, tending to entrap gases held in the castings, with blistering of the enamel as a result.

While certain dry process enamels do give good results when used by the wet process, as stated by Mr. Manson, our results in the application of dry process enamels to this method clearly show that this is not true in all cases and that very unsatisfactory results can be expected with certain other types.

Reply to Mr. Lindemann by Mr. Danielson:—Mr. Lindemann's discussion is of value because it not only gives additional concrete information, but also because it raises the question of the proper use of laboratory results in improving manufacturing processes. It is well to emphasize the fact that a laboratory investigation of this kind is designed to develop information regarding the technic and the probable limits of composition as well as the effect of varying constituents in the compositions in order that defects may be corrected.

Mr. Lindemann's statement, that the various operators must become familiar with the preparation and application of a certain enamel to obtain best results, is very true. Enamel compositions developed in this as well as other investigations have given satisfactory results in some plants, while in others the reverse has been true, due undoubtedly to variations in technic encountered in the several plants. While the development in the laboratory of enamels applicable to all factory conditions is desirable, it is not to be presumed that all compositions so developed will prove practicable without their modification along lines suggested by the results of the systematic laboratory investigation.

Additional light can perhaps be thrown on the seeming discrepancies between the author's summary and Mr. Lindemann's experience by the following notes:

From the results of the preliminary work done at Mr. Lindemann's plant, Rg-7 was reported as having a comparatively short firing range and it was for that reason that it was not included in the list of the more promis-

ing compositions. Evidently Mr. Lindemann's operator is skilful enough to use it successfully, showing that we were playing over-safe in excluding it from the list of desirable enamels.

From our knowledge of these compositions it seems probable that Mr. Lindemann's objection to the cover enamels R-28 and R-18 was lack of opacity. These covers are more particularly adapted to those factory conditions, which are not uncommon, which make it desirable to use a cover which will cover satisfactorily in all cases even though it is necessary to apply several coats in order to attain sufficient opacity. Several compositions with particularly good texture and burning range but somewhat low in opacity were included to meet such conditions, and by no means should these be excluded from a field of commercially usable enamels.

WATER COOLING OF GLASS TANKS[1]

MR. PAYNE:—We have been very much interested in the subject of water cooling. About a year and a half ago we obtained a list of the companies having water coolers on their tanks. Included in that list were about fifteen different concerns. We sent out a questionnaire and in almost all cases I received answers. I will say that about ten of the companies replied that they had them in for a short time, but were unable to get definite results at the time of writing. About three or four of the companies were very enthusiastic about their use. Two were really noncommital or adverse to them. In those cases it seemed that the question of the purity of the water was a great factor. The real question, however, is whether 18- or 24-inch water coolers are desirable.

THE CHAIRMAN:—What contact do you have between the refractory and the metal container?

MR. PAYNE:—Simply a ground surface. We use no cement.

THE CHAIRMAN:—How long have they been in operation?

MR. PAYNE:—About a year. We are not saying very much about it, but they are a little better than the old style.

THE CHAIRMAN:—Has anyone else any experience with water coolers?

MR. YUNG:—I don't know, but I think that I was one of the first to start the water cooling proposition in glass house tanks. I might give you a little idea of the way the thing developed, and how disappointed I was at the finish. In the first place, we had a very corrosive glass, and the life of the tank was very short. I conceived what I thought a very brilliant idea one time of making a repair on the tank. The box was eaten through in spots, and it had been the practice of the men in the factory to pack this hot spot with the block, and the block on there would

[1] Glass Division, St. Louis Meeting, March 1, 1922.

overheat this particular spot. The glass came through, and I thought I had a wonderful scheme. By means of a piece of sheet iron I could distribute the heat developed on that particular spot over a larger area, the iron being a good conductor, and conduct the heat away from this hot spot. I tried that out and it worked very satisfactorily in sections over twelve inches square, and where the hot spot was perhaps five or six inches in diameter. On this water was turned, and the plate acted as no protection against the water. That held the tank with those holes in it, for a matter of six months, with these steel plates and the weak spot. And after that it looked so good, we tried the whole rear end of the tank with the sheet metal, covered it and pressed it up against the tank block as closely as possible, and put an extra underneath it to gauge the flow of water; in six weeks, as I remember, the whole melting end of our tank was eaten out. Then we made a hot repair and replaced the whole rear end of this tank and in the meantime with the hope of the thing being successful I had gone into the water jacket of the cooler. That happened to be installed before the development of this sheet on the back of the tank. These coolers were installed in short order. I think it was three or four months—and this tank went out. Considerable investigation was made of the blocks with accurate instruments, and it was readily seen by observation, whenever there was an opportunity of looking down between the water cooler jacket and the place. You could see the heat throughout the entire length of the furnace showing that instead of the blocks running cooler with the water jacket on it, they ran hotter, the explanation being that it was practically a loss, at least so far as getting a binder which would furnish a contact. Not having that, the air space in between acted as an insulator, and the coal ran hotter than it would without any cover on it at all.

MR. GRAFTON:—*Speaking from the tank block manufacturer's standpoint*, I don't believe there is any doubt but what a water cooled tank will get more service from the tank blocks than those without. I know several factories, one in particular, where they have an air cooled system, that is a volume of air blowing on all the joints, and I know this prolonged the life of that tank. At the same time, a glass company at Evansville, Indiana, have a system of their own, consisting of a two-inch pipe surrounding the tank filled with water, over the throat and everywhere, to resist the heat. They have also prolonged the life of their tank. At the Johnson Glass Company of Hartford City, the conditions referred to by Mr. Yung were different. The blocks were entirely gone around the dog house and were entirely eaten out to a point eighteen inches below the surface. The glass was resting against the water coolers. I was talking to a manufacturer not long ago in regard to the repairs of his tank. He was holding up the repairs because he was considering the installation of water coolers,

but he finally gave the matter up, for the reason that the cost of furnishing water to these coolers, even though they prolonged the life of his tank for six or eight months, would cost him more than repairing his tanks with new blocks.

MR. BROWN:—If you go into water cooling, you can easily use up 300,000 gallons a night.

MR. CHAIRMAN:—Use it up or circulate it?

MR. BROWN:—That is up to you.

MR. FORSYTH:—We are experimenting a little bit with this, but only a trifle. The amount of water required, even on a small cooler, is a large item. The first thing you have to consider is the amount of scale deposited by your water. What would be the efficient temperature to run your water from the overflow to these cooling tanks? If you were running the water straight through the cooler to the sewer, naturally you would want to run that at as high a temperature as possible. But apparently there is no data on the amount of the settling on any particular water as you raise the temperature from the temperature of the main to the boiling point, and the only way would be to have some kind of a cooling system—tanks or otherwise—in which you eventually move all the salts that will precipitate out of your water. Then the only amount of water you have to add from your mains is that due to evaporation during your cooling. Unfortunately, in our plant we are not situated so that we can install this kind of a system and we have to run the water into the sewer. It certainly requires a large amount of water, especially when you are not sure how much of the temporary hardness will be precipitated out. To my notion, it seems our waste water will run out at a low temperature, which is better than taking the chances of heating up and depositing scale, even though the water jackets are equipped with a so-called "wash-out" system.

MR. BROWN:—There is a difference between hard and soft water. You had better get your water softer if you are going to use coolers.

MR. FORSYTH:—In using the water over and over again, you eliminate that.

MR. BROWN:—It then comes down to a question of water purification.

MR. WILLIAMS:—I would like to suggest that water cooling is probably a step in the wrong direction in solving our tank problems; not but that water cooling might be a temporary remedy for maintaining the life of a tank, but after all, the weakness is in the refractory. Further cooling is carrying off a lot of heat rather than saving it, and after all is said and done, what we are after is heat economy as well as tank life. It should be "insulation" and not a matter of "cooling by water" which should be the solution of tank life and heat economy at the same time. I mention that point so that in this discussion we won't lose sight of the fact that maybe

that is not the right way to do it after all, but the ultimate desirable way is "insulation" and heat economy.

THE CHAIRMAN:—I notice Mr. Wright has just come in. I am sure he can contribute something to water cooling of tank blocks.

MR. WRIGHT:—I think my experience has been possibly of a practical nature, something similar to those who used the water jackets for cooling tank blocks. I notice that the tank blocks wear away faster at the start than if they are air-cooled. From the time the block begins to get thin down to the point where it is one or two inches thick, the water jacket seems to be of help. I have heard of several places where water jackets have failed, but it was not necessarily due to the fact they were water jackets. The experience at a plant not very far from ours was that about three weeks after they started they lost a tank, and I think it was due to the fact they had dirty water; they allowed the water jackets to become filled with sediments, and the water jackets acted as insulators rather than a cooling medium.

MR. BELLAMY:—I haven't had any experience with water coolers, but what has been said has resolved itself into a case of transferring the cold from the water to the tank blocks, and in those cases, where it has worked, it has been a case where the circulating water has cooled the block and the other was where the contact between the cooler and the block has not permitted the transfer.

THE CHAIRMAN:—Mr. Williams mentioned the case of a steel furnace. The steel men evidently have analyzed their costs, and they have come to the conclusion, that even though they do burn up a furnace in a short time, they are ahead of the game. But in the glass industry we perhaps don't realize the relative cost of material and tank refractories. I think if detailed costs were set up for tank blocks and refractories, we would find the cost of repair is insignificant compared with tonnage we can get off. In other words, what I am trying to say is, there is a point where we can force our tanks harder with shorter life and finally be better off than if we nurse along the tank blocks.

A MEMBER:—Doesn't that statement hold good as applied to water coolers? If you put a water cooler on the side of the tank, the only service it seems to me is to keep the block cool, to keep it from wearing away; that means you are taking heat away from your furnace continually, and not only have the cost of pumping the water, but also have the cost of heating that water, which naturally comes on your coal bill. And it seems to me the increased cost of fuel consumption or increased cost of the coal which you would be using would, to a very large extent, offset any advantage you would get from your water cooler, and you might be better off to allow your blocks to burn out and replace them more frequently, than to have a vapor heat that way.

THE CHAIRMAN:—That is something along the line I had in mind. It is an investigation of your cost as distributed over tank repairs and fuel cost. Fuel cost is a big item. Mr. Brown has said it takes 300,000 gallons of water a day to cool something or other down in Charleroi. 300,000 gallons of water a day certainly runs into money. I think it is up to the tank block people to give us blocks that won't corrode. I think we are all agreed on that. Let us hope that this is just a temporary expedient, and we will get refractories that will stand up. I think Mr. Williams' point on that is exceedingly well taken. Of course, I am in the glass business and not the tank block business.

ACTIVITIES OF THE SOCIETY

A MESSAGE FROM PRESIDENT RIDDLE

Membership

Our Sporting Editor, in the October issue of the *Journal*,[1] announced the close of the Base Ball Season.

Past experience has shown that football is far more popular among our members than base ball. It is reasonable to suppose that the same condition will continue this year. So far the 1922 reports show an increase of 189 personal and 60 corporation members.

Our athletic board is very capable and Athletic Director Purdy is too well-known to require an introduction. Some of you have not met Manager Bowman but you will hear more of him before the year is over. The publicity department, under the direction of Miss Van Schoick, is doing all that can be asked. It is understood on good authority, however, that Coach Binns is in need of more raw material if she is to develop seven good division teams. A good many are fine on the defensive but what we really need are a lot of good tacklers. Miss Binns believes in open play; in fact, she states that the farther you are from Columbus the better, as long as you tackle, as you may get somebody going around the end, with whom no one else could get in contact.

Advertising

A study of the financial statement for September and a comparison of the receipts and estimated income as shown by the Budget prepared last February bring out several interesting points. Our Budget shows an estimated income for 1922 dues and subscriptions of $20,500 while the receipts for the first nine months are very close to $17,000. This, the accounts receivable and the revenue to be received from additional memberships, provided you do all Coach Binns expects of you, will bring the total receipts from these two sources well up to the estimated figure.

The receipts from advertising, however, have not shown the increase which was anticipated nor which a great many feel the increase in the circulation of the *Journal* warrants. We have a capable, experienced advertising manager but no matter how hard he may work he will not be able to continue to sell advertising without your support. Advertisers primarily judge a journal by its circulation, considering not only the number of people reached but also the character of those people and their ability to buy the particular commodity which is being marketed. This primary judgment will sell advertising in the beginning but it will not continue to sell it unless the merchant feels he is getting proper returns.

Comparison of the total volume of business done before and after undertaking an advertising campaign is one method of determining the value of the advertising; however, a good many merchants keep account, as far as possible, of the increase in sales due to advertising in each particular medium. Here is where you can be of great benefit to the Society.

1. Do you read the advertisements in our *Journal?*
2. When you write to an advertiser in the *Journal* do you tell him you read his advertisement in the *Journal?*
3. When you read an advertisement in another journal that ought to be in ours, what do you do?

[1] *Bull. Amer. Ceram. Soc.*, **1**, 254 (1922).

4. Do you realize that if you interest somebody in placing a full page advertisement in our *Journal* for a year you are helping as much as if you secured sixty new personal members?
5. Should you be advertising in the *Journal?*

Please think these points over. Get in touch with our Advertising Manager, LeRoy W. Allison, 170 Roseville Avenue, Newark, New Jersey.

PAGE THE CHEER LEADER!

The football squad of the American Ceramic Society has already made a record for itself. Two full teams are in the field and although nine or ten of the men are new material they are all making good.

Wainford was the big man of the team this month, as by several spectacular plays he gained forty yards in the second quarter and completed a forward pass to Bowman. Lemley also starred, making a twenty-yard gain around left end and completing a forward pass to Office. Parmelee, Rochow, Cox, J. B. Shaw, Lindemann, and Blumenthal made consistent plunges through the line for twenty yards each. H. S. Kirk on a trick play gained ten yards around right end and completed a forward pass to Rhead. O. O. Bowman 2nd was good for two forward passes. Substitutes were sent in at various times and showed much promise. Landrum, Rhead, W. J. Rees, G. H. Brown, Howat, Stern, Gaudette, Bales, Gilfillan, and Moulton were each good for ten yard gains, and Nickerson completed a forward pass to Office. The climax came, however, when in the last minute of play S. Momoki, the diminutive Japanese end, got the ball on a fumble and made a thrilling run for a touchdown. The referee unhesitatingly declared the game a victory for the October side, and nothing but the proximity of the ceramic department with its classes of earnest students pursuing solemn figures across mournful blackboards prevented the office force from doing a snake dance down the hall. The record of each man on the team follows:

	Personal	Corporation		Personal	Corporation
C. W. Parmelee	2		J. B. Shaw	2	
W. F. Rochow	2		W. C. Lindemann	2	
Paul E. Cox	2		H. S. Kirk	1	1
R. D. Landrum	1		Charles Gaudette	1	
R. H. Wainford	4	1	Geo. Blumenthal	2	
F. H. Rhead	1		C. E. Bales	1	
W. E. Lemley	2	1	J. M. Gilfillan	1	
W. J. Rees	1		D. A. Moulton	1	
G. H. Brown	1		O. O. Bowman, 2nd		2
W. L. Howat	1		F. P. Nickerson		1
Newton W. Stern	1		S. Momoki		3
			Office	2	3

Total: 31 Personal, 12 Corporation

The net increase for the first nine months of this year is:

	Personal	Corporation	Total
October 16, 1922	1567	211	1778
January 1, 1922	1350	139	1489
Net increase	217	72	289

The gross increase in membership by periods since June 1921 is:

	Personal	Corporation	Total
June to September 1921	41	11	52
September to December	18	2	20
December to February	136	21	157
February to May	81	10	91
May	13	13	26
June	13	5	18
July	25	11	36
August	20	5	25
September	31	11	42
October	31	12	43
	409	101	510
Loss	82	5	87
Net increase	327	96	423

NEW MEMBERS RECEIVED FROM SEPTEMBER 15 TO OCTOBER 15

Associate

Archie, Charles L., Box 265, Corinth, Miss., Supt., Corinth Brick Co.

Armstrong, Robert E., 312 East 13th St., Indianapolis, Ind., Salesman, Harbison-Walker Refractories Co.

Atwell, Donald B., 4447 Washington Blvd., St. Louis, Mo., Evens & Howard Fire Brick Co.

Bisby, Grace Griswold, Pinos Altos, New Mexico, Supt., Grant County Schools.

Camp, Arthur D., Box 503, Williamsport, Pa., Supt., Williamsport Building Products Co.

Carter, J. Guild, Trenton Flint and Spar Co., Trenton, N. J., Sales Representative.

Chiang, Kuan-Tsen, 1305 Yale Station, New Haven, Conn., Student.

Coss, Harold T., Y. M. C. A., New Brunswick, N. J., Student, Rutgers College.

Cuffin, John, 208½ North 22nd Street, Portland, Oregon, Supt., Denny-Renton Clay and Coal Co.

Girling, William G., c/o Henry Foster & Co. Ltd., Backworth, Newcastle-on-Tyne, England, Director and Works Mgr.

Habas, Sol, 634 S. Warren St., Trenton, N. J., Student, Rutgers College.

Hanna, Ralph E., 149 Rector St., Perth Amboy, N. J., Chemist, Atlantic Terra Cotta Co.

Hoehn, Charles J. P., 2902 Nineteenth St., San Francisco, Cal., Pres., Enterprise Foundry Co.

Holley, Kenneth E., Alfred, N. Y., Student, New York State School of Ceramics.

Howes, George W., Dowagiac, Mich., Gen. Supt., Beckwith Co.

Johnson, A. G., 115 Hyland Ave., Ames, Iowa, Student, Iowa State College.

Kane, Evan O'Neill, Jr., Kushequa Brick Co., Kushequa, Pa., Asst. Mgr.

Ludlow, George M., 565 Washington Blvd., Chicago, Ill., Pres., Sanitary Scales Co.

McAfee, William K., 305 Highland Ave., New Castle, Pa., Engineer, Universal Sanitary Mfg. Co.

McCall, Gilbert, 685 Thurman St., Portland, Oregon, Foreman, Denny-Renton Clay and Coal Co.

Martin, George M., 894 E. State St., Trenton, N. J., Keystone Pottery Co.

Mason, T. Harry, 45 S. Hermitage Ave., Trenton, N. J., Supt., International Pottery Co.
Ockerman, Elmer H., Alfred, N. Y., Student, New York State School of Ceramics.
Schepers, Francis A. H., 1021 Emerald Ave., Chicago Heights, Ill., Chemist, Advance Terra Cotta Co.
Sheerar, Leonard F., Alfred, N. Y., Student, New York State School of Ceramics.
Smith, Leon B., Alfred, N. Y., Student, New York State School of Ceramics.
Snyder, Hiram T., Louisville Pottery Co., Louisville, Ky., Gen. Mgr.
Turner, William, 837 Plum St., Trenton, N. J., Trenton Potteries Co.
Wainford, Henry R., Jr., 2241 Chestnut Ave., Trenton, N. J., Asst. Supt., Trenton Flint and Spar Co.
Willson, B. W., 322 Seventh St., Ames, Iowa, Student, Iowa State College.
Wysor, D. C., 40 Rector St., New York City, Mgr., Missouri Field, General Chemical Co.

CORPORATION

Canadian General Electric Co., Toronto, Ont., Canada.
Denny-Renton Clay and Coal Co., Seattle, Wash.
The Electrical Refractories Co., East Clark St., East Palestine, Ohio.
Globe Brick Co., Box 765, East Liverpool, Ohio.
Hardinge Co., Inc., 120 Broadway, New York City.
Iron City Sanitary Mfg. Co., 1514 Oliver Bldg., Pittsburgh, Pa.
Nippon Gaishi Kwaisha, Higashimatch, Nagoya City, Japan.
Nippon Toki Kwaisha, Noritake, Nagoya City, Japan.
Toyo Toki Kwaisha, Shinozaki, Kokura City, Japan.
The W. S. Tyler Co., Cleveland, Ohio.
Universal Sanitary Mfg. Co., New Castle, Pa.
Wainford Darling Co., Trenton, N. J.

WHO'S WHERE IN THE AMERICAN CERAMIC SOCIETY?

Howard C. Arnold has notified the office of a change of address in St. Louis, Mo., from 4906 McPherson Avenue to 4020 McRee.

Erling E. Ayars, of the American Refractories Co., has been transferred from Devils Lake, Wis., to Joliet, Ill.

W. W. Coates, Jr., has moved from Lawrence, Kansas, to St. Joe, Mo., where he may be addressed at the Y. M. C. A.

Earl Curry, of Willoughby, Ohio, who graduated from the ceramic department of Ohio State University last June, has accepted a position with Gladding McBean & Co., at Lincoln, Cal.

R. P. Herrold, of Zanesville, Ohio, where he is with the Mosaic Tile Co., has moved from Brighton Blvd., to 325 Adair Ave.

Herford Hope recently sent in to the office his new address which is, Liverton, near Newton Abbott, Devon, England.

C. E. Jackson, of the Warwick China Co., Wheeling, W. Va., has just returned from a trip to Europe.

Thos. N. Kurtz has severed his connection with the Standard Refractories Co. and has moved to 524 Penn St., Hollidaysburg, Pa.

P. William Lee, of Denver, Colo., has moved from Race St. to 507 Downing St.

Donald M. McCann, formerly of Zanesville, Ohio, has taken a position with the Sterling Grinding Wheel Co., Tiffin, Ohio.

F. L. Steinhoff, Managing Editor of *Brick and Clay Record,* has changed his residence in Chicago from Kedzie Ave. to 1122 East 67th St.

W. J. Sutton, a graduate student and assistant in chemistry at the University of Pittsburgh, has moved from Bellefield Ave. to 328 1/2 N. Craig St., Pittsburgh.

Boris Trifonoff, formerly with the American Encaustic Tiling Co. at Zanesville, may now be found at 1244 N. Elm St., Muncie, Ind.

SOME OF THE LOST ARE FOUND

The Secretary acknowledges with appreciation information received from members of the Society with regard to the lost addresses printed last month. Six names have been restored to the rolls. The remaining unknowns are here listed in the hope that further information will be forthcoming.

Baker, G. V., Penn Feldspar Co., Philadelphia, Pa.
Bickel, Earl A., Postville Clay Products Co., Postville, Iowa.
Bramlett, Mrs. J. T., Enid, Miss.
Brett, R. C., Southern Clay Mfg. Co., North Birmingham, Ala.
Callaghan, J. P., c/o Teaque Hotel, Montgomery, Ala.
Dolley, Charles S., Keramoid Mfg. Co., Fort Madison, Iowa.
Greenwood, John L., Lehigh Sewer Pipe and Tile Co., Lehigh, Iowa.
Groocock, Alice, 865 Bathurst St., Toronto, Ont.
Henshaw, S. B., Libbey-Owens Sheet Glass Co., Charleston, W. Va.
Kitamura, Y., Shofu Kogo Kafushiki Kaisha, Kyoto, Japan.
Knote, J. M., Mines Dept., Sault Ste. Marie, Ont.
Lodwick, J. A., American Arch Co., 17 East 42nd St., New York City.
Meissner, Max, Sprague Canning Machine Co., Hoopeston, Ill.
Miller, J. J., Mellon Institute, Pittsburgh, Pa.
Mitchell, Leon W., Rock Island Stove Co., Rock Island, Ill.
Morrow, Robert P., Harbison-Walker Refractories Co., 1513 Rockefeller Bldg., Cleveland, Ohio.
Pendrup, W., Coonley Mfg. Co., Cicero, Ill.
Pire, Mrs. Ward L., 1745 East 116th Place, Cleveland, Ohio.
Pulsifer, H. M., Geo. H. Holb & Co., Chicago, Ill.
Ragland, N. A., Alberhill Clay and Coal Co., Los Angeles, Cal.
Reid, W. H., 10 Stanley Place, Yonkers, N. Y.
Risch, Edward J., 4935 Roscoe St., Irving Park Sta., Chicago, Ill.
Smith, Harry W., Roessler & Hasslacher Chemical Co., Box 360, Cleveland, Ohio.
Stewart, John G., 530 Union Trust Bldg., Cincinnati, Ohio.
Tefft, T. D., Hamilton, Ont.
Vodick, William J., 1733 Lake Ave., Wilmette, Ill.
Walcott, A. J., Bausch & Lomb Optical Co., Rochester, N. Y.
Yamamoto, Tamesburo, Yamatame Glass Mfg. Co., Osaka, Japan.

TWENTY-FIFTH ANNUAL MEETING

Silver Jubilee

Plans are being made for an unusually-important program at the annual meeting in Pittsburgh, February 12–16, 1923. Leading men in ceramics and allied industries will be invited to participate in the opening session; the charter members of the Society will be honored at the banquet; and each division will have four sessions for the presentation of papers and discussion.

Since the January number of the *Journal* is to be devoted to a review of the history of ceramics and of the Society for the twenty-five years past, the period of the annual meeting will be devoted to a consideration of present and future problems.

A strong local committee has been appointed under the chairmanship of A. F. Greaves-Walker. The personnel is as follows:

EXECUTIVE COMMITTEE

A. F. Greaves-Walker, *Chairman*
E. W. Tillotson, *Vice Chairman*
R. M. Howe
A. Silverman
J. W. Hepplewhite, *Secretary*

RAILROAD TRANSPORTATION

C. C. Phillips, *Chairman*
Robert F. Ferguson
J. E. Hansen

HOTEL ACCOMMODATIONS

A. H. Chandler, *Chairman*
A. E. Blake
J. L. Crawford

PUBLICITY

Arthur W. Kimes, *Chairman*
John M. Hammer
E. W. Tillotson

SERVICE

H. G. Schurecht, *Chairman*
H. G. Elledge
Arthur E. Gray
Willard J. Sutton
W. F. Wenning

SMOKERETTE

Raymond M. Howe, *Chairman*
F. G. Lord
H. S. Robertson
Drew M. Thorpe

BANQUET

Alexander Silverman, *Chairman*
M. G. Babcock
H. L. Dixon
F. W. Donahoe
C. R. Peregrine
Francis W. Walker, Jr.

RECEPTION

J. Spotts McDowell, *Chairman*
Chas. R. Fettke
Francis C. Flint
H. C. Fry
Samuel M. Kier
Chas. J. Kirk
Donald W. Ross
H. G. Willets
E. J. Winkleman

FINANCE

Henry L. Dixon, *Chairman*
Marion G. Bryce
Porter Kier
J. M. Lambic
Kenneth Seaver
Thos. Wilson

ENTERTAINMENT OF LADIES

Mrs. A. F. Greaves-Walker, *Chairman*
Miss Edna P. Carson
Miss Mabel C. Farren
Mrs. H. L. Dixon
Mrs. R. M. Howe
Mrs. Alexander Silverman
Mrs. E. W. Tillotson

TRIPS

J. Spotts McDowell, *Chairman*
D. M. Buck
J. W. Cruikshank
L. P. Forman
Marsden H. Hunt
F. K. Pence
Francis W. Walker, Sr.

A Letter from the Pittsburgh Chairman

Pittsburgh, Pa., October 17, 1922

To the Members of the American Ceramic Society:

The next annual meeting of the Society will be held in Pittsburgh, Pennsylvania, February 12 to 16. This will be the twenty-fifth anniversary of the birth of the Society and we are, therefore, referring to it as the Silver Jubilee Convention. Pittsburgh was selected for the celebration of this occasion because it was in this city that the original plans for the Society were laid twenty-five years ago.

The Local Committee, in conjunction with the officers of the Society, are planning to make this the biggest and most enthusiastic meeting the Society has ever held, and it is hoped that every member of the Society will accept this as a most cordial invitation to be present. It is confidently expected that from seven hundred to eight hundred members will attend.

The Local Committee has already laid its plans. The general meeting will be held at the William Penn Hotel, which will also be headquarters for the Society, on the 12th, as will also the Banquet on the evening of that day. On the evening of the 14th the Smokerette, which will this year include dancing, will be held at the William Penn. The Fort Pitt Hotel will be used for Divisional Meetings, of which this year there will be four instead of three as in previous years. The evening of the 13th has been purposely left open by the Committee with the idea that it could be used for little social gatherings and for Alumni dinners and meetings.

It is planned by the officers of the Society to invite for this Silver Jubilee Convention a number of the most prominent scientific and technical men in the country and it is expected that several of these will be heard at the Banquet. It is expected that there will also be a full attendance of the charter members now living, which will add greatly to the occasion.

Plans have been made to entertain the largest attendance of ladies and it is sincerely hoped that every member who can will make it a point to bring his wife with him.

On account of the large attendance expected it is not too early to make hotel reservations. This can be done by addressing either the William Penn or Fort Pitt Hotels, or the Chairman of the Local Hotel Accommodations Committee.

Sincerely yours,
(Signed) A. F. Greaves-Walker, *Chairman,*
Executive Committee, 25th Anniversary Meeting

REPORT OF COMMITTEE ON RULES

Amendments to the Constitution

Herewith are amendments covering two classes of memberships (*a*) *Ex Officio* Honorary, (*b*) Perpetual. These were proposed in August 1921, were considered and finally approved by Committee on Rules and Committee on Membership acting jointly. They were not presented to the Society at the St. Louis Convention so as to give the 1922 Rules Committee opportunity to review them. They were finally presented at the September 15, 1922 meeting of the Society in New York City.

Ex Officio Honorary Members: This Society has at times honored officers of the ceramic societies of other countries by electing them to honorary membership during the term of their official incumbency. No distinction has heretofore been made between our "life" Honorary and these "temporary" Honorary memberships.

Perpetual Active Memberships: The conception behind provisions here proposed cover the "life" membership and the "permanent endowment" ideas with which our parliamentarians have for long been working. The amendments here proposed give opportunity to pay an endowment fee, the interest earnings of which will cover all regu-

lar dues during the life of the member as in the customary "Life Memberships;" and at the death of the member the fee will be transferred to a permanent research endowment fund, and the name of the member forever kept on the roster of the Society appropriately designated as having so contributed to the support of the work of the Society.

Proposed Amendments to Constitution and By Laws

Article II

#1 The Society shall consist of Honorary, *Ex Officio* Honorary, Active, Perpetual Active, Associate, Corporation and Industrial Association and Perpetual Corporation Members.

#4 *Ex Officio* Honorary Members must be such officers of such other associations and societies as shall be unanimously designated by the Board of Trustees, the name of the person holding such office appearing on the Society roster as *Ex Officio* Honorary Members during the term of his incumbency only.

#5 Same as present #4.

#6 Same as present #5.

#7 Perpetual Active Members must be those members, active or associate, who make single payment of an endowment fee as prescribed in Article III. Their names shall appear on the Society roster perpetually. Perpetual Active Members shall have the same rights as Active Members.

#8 Same as present #6.

#9 Same as present #7.

#10 Perpetual Corporation Members must be persons, firms, or corporations who make single payment of an endowment fee as prescribed in Article III. Their names shall appear on the Society roster perpetually. Perpetual Corporation Members shall have the same rights as Corporation Members.

#11 Same as present #8.

#12 All Honorary Members, *Ex Officio* Honorary Members, Active Members, Perpetual Active Members, Associate Members, Corporation Members, Perpetual Corporation Members and Industrial Association Members shall be equally entitled to the privileges of membership, except that only Active, Perpetual Active, one representative of each Corporation Member, and one representative of each Perpetual Corporation Member shall be entitled to vote. Such representative shall be officially designated by the person, firm or corporation represented. Only Active and Perpetual Active Members shall be entitled to hold office. The roster of each grade of membership shall be printed separately in at least one publication issued by the Society annually.

#13 Any person may be expelled from any grade of the membership of the Society if charges signed by five or more Active or Perpetual Active Members be filed against him or her, and if the Board of Trustees examine into and sustain said charges by a majority vote. Such person, however, shall be notified of the charges against him and be given a reasonable time to appear before the Board of Trustees or to present a written defense before final action is taken. In case of such expulsion, any moneys paid the Society as endowment fees become forfeit to the Society and automatically become part of the research fund.

Article III

#1 Honorary and *Ex Officio* Honorary Members shall be exempt from all fees and dues.

#3 Perpetual Active Members shall pay a single endowment fee of $200.00,

the interest earnings from which shall be used during the life of the member for current expenses. Upon the death of the member, the interest shall be used according to the direction of the Board of Trustees for ceramic research. The privileges of membership shall begin upon payment of this fee.

#4 Same as present #3.

#5 Perpetual Corporation Members shall pay a single endowment fee of $600.00, the interest earnings from which shall be used for current expenses for a period of twenty-five years after which time the interest shall be used according to the direction of the Board of Trustees for ceramic research. The privileges of membership shall begin upon payment of this fee.

#6 Same as present #4.

T. A. Kleinfelter,
Chairman, Committee on Rules

Amendments Proposed by Ten Members

Article XII of the Constitution makes provision for any ten members presenting proposed amendments the same to be read at a regularly called meeting of the Society and voted upon by letter ballot by the Active Members. The following two amendments were thus presented by Mr. Homer F. Staley and nine others:

(1) **Elimination of "Associate" Members.**

Article II.—Membership

(1) The Society shall consist of Honorary, Active, Corporation and Industrial Association Members. All members of the former "Associate" grade are hereby made Active Members.

(4) Eliminate.

(5) Eliminate.

(6) Active Members must be persons interested in the ceramic or allied industries.

(9) Eliminate "Associate Members."

Article III.—Dues

(2) Eliminate "and Associate."

By-Laws

Section IV. Eliminate "and Associate."

Section VII. (3) Change "Associate" to "Active."

(2) **Change in Board of Trustees and Method of Electing the Board Members.**

Article IV.—Officers

(1) The affairs of the Society shall be managed by a Board of Trustees consisting of the President, the Vice-President and as many Trustees as there are Divisions of the Society. The President and Vice-President shall be elected as prescribed in Article V to serve one year. One Trustee shall be elected annually by ballot by each Division at the last session of the Division held during the annual meeting of the Society. A Trustee may be reëlected to serve not more than three consecutive years.

(9) A Treasurer shall be appointed by the Board of Trustees for a term of not more than two years. (Then continue as formerly.)

Article V

Eliminate "Treasurer and one Trustee." Put "and" between "President" and "Vice-President."

SHALL I JOIN THE SOCIETY NOW?

At this time of year new members are sometimes dismayed at the information that payment of dues now does not preclude the receipt of a bill for 1923 dues on January first, since all memberships are considered as extending from January to January, and payment of dues at any time of the year entitles a member to all the *Journals* for that year.

The reasons for this practice are two. Most members wish to have the *Journal* in complete volumes, and the Society finds it advantageous to keep the stock of the different numbers as uniform as possible.

"But," we hear someone say, "I don't want to receive nine or ten *Journals*, back numbers, all at once."

The answer to this is found in the casual remark of a Columbus man who joined the Society in September. He came into the office one morning and said, "Well, nine *Journals* arrived in my mail this morning and I have glanced at the tables of contents. I see thirty articles of direct interest to me and many more of indirect interest."

We thanked him and jotted this down on our solid ivory tablets for use in the Bulletin.

We believe that a man who joins the Society in September, or even December, and pays a year's dues, gets his money's worth before he receives a bill for the new year's dues in January. The Annual Meeting, with each of the seven divisions carrying a crowded program, provides papers for the entire year, so that most of the material appearing in the last issues of any year are no older, so far as investigation and experiment are concerned, than those which are used in the earlier numbers. Then too, discussions printed in November, for example, may refer to original papers printed in May; while the index in the December number would be of little importance to a member if the last two or three numbers only were in his possession.

New applicants are given a chance to elect whether they will join as of the old year or as of the coming year, when they are accepted for membership during the last three months. But we feel that, did they understand what they would receive or what they would miss, according to their decision, there would be little hesitation about paying dues at once, regardless of the fact that another bill would be forthcoming in January. Furthermore, three months' grace is given for the payment of the January bill.

REPORT OF COMMITTEE ON NOMINATIONS

Officers for 1923 and Trustee to Serve Three Years

For President, A. F. Greaves-Walker
For Vice-President, Robert D. Landrum
For Treasurer, Ralph K. Hursh
For Trustee, Ralph R. Danielson

ABSTRACTLY SPEAKING

It is a matter of pride in the editorial office and, we hope, satisfaction to the members of the Society, that the number of Abstracts from our own staff is increasing. This month, out of 164 abstracts, 116 are from our own abstractors. It has been our aim to have the ratio of our own Abstracts to those from *Chemical Abstracts* at least 2 to 1, and not 1 to 2 as it had to be before we were "abstractedly self-supporting." J. L. Crawford, J. W. Hepplewhite, R. M. Howe, H. P. Hood and R. R. Danielson have been added to the list of abstractors.

NORTHERN OHIO SECTION

The sixteenth regular meeting of the Northern Ohio Section was held on October 10, at Hotel Winton, Cleveland. Lunch was served at 1 P. M. after which the technical program was taken up.

Mr. B. A. Rice, ceramic chemist with the Elyria Enameled Products Company, introduced a discussion of the determination of the physical properties of enamels, such as the coefficient of expansion, adhesion, and the elasticity. These three are the properties which would seem to be connected with the tendency to fishscale. An interesting account was given of experiments made on enameled ware, and of attempts to form the enamel into a rod or bar by pouring into heated molds, also suction. The problem of forming a specimen of accurate, uniform dimensions seems to be the greatest stumbling block.

Mr. J. H. Forsyth, Glass Technology Department of the National Lamp Works, gave a lively account of the main features of the Society's Canadian trip.

A visit was made by some of the members to the Research Laboratory of the National Malleable Castings Company, where the unusual facilities for high temperaure work and mechanical testing proved of great interest.

A. F. GORTON, *Secretary*

NEW ENGLAND SECTION

At a special meeting of the Executive Committee of the New England Section, O. S. Buckner was appointed Chairman and C. W. Saxe, Secretary, for the balance of the year 1922. Both Mr. Buckner and Mr. Saxe are with the Norton Company, Worcester, Mass. Plans are being made for a meeting of the Section at Worcester on October 28.

NOTES AND NEWS

THE PROBLEM OF PLASTICITY TO BE STUDIED

THE RESEARCH COMMITTEE, WM. H. CLARK, CHAIRMAN, MAKES THE FOLLOWING ANNOUNCEMENT

Of prime importance to ceramists is the proposed research to be pursued at Lafayette College, Easton, Pa., under Professor Eugene C. Bingham, on the fundamental problems of plasticity, provided funds to finance the work are forthcoming.

Those who have seen his invaluable book "Fluidity and Plasticity,"[1] recently published, will not question Professor Bingham's authority and power to handle this subject.

The Research Committee of the American Ceramic Society endorses the proposed plan of research and urges individuals and firms to contribute to the fund for the purpose.

The General Electric Company has subscribed $1,000 with this comment:

"We had your book of the Talbot Series, and it seemed to us that, if any type of research outside of our strict local laboratory undertakings should receive financial assistance from this Company, it is that which you are carrying on."

Subscribers may send their contributions to R. C. Purdy, General Secretary, American Ceramic Society, Lord Hall, Ohio State University, Columbus, Ohio, with the assurance that such will be promptly forwarded.

Professor Bingham's clear statement of the needs and purposes of his plan follows:

Dear Sirs:—

For several years research work on the subject of plasticity has been carried on at Lafayette College, in the Gayley Laboratory. The results are now generally available in

[1] See review, *Ceram. Abs.*, **1**, 172(1922).

a book published by McGraw-Hill Book Co., entitled "Fluidity and Plasticity." Enough has been done to show that paint, rubber, nitrocellulose, starch, metals and their alloys, road-building materials, and many other colloids are plastic materials and not viscous liquids as heretofore assumed. This changes our conceptions, for we are really dealing with two properties, yield value and mobility, instead of the one property, viscosity. The relationships are apparently governed by simple laws, but our knowledge of the whole subject is very fragmentary.

We have an Edward Hart Fellow and a du Pont Fellow engaged in working out these problems, but the work is painfully slow and with a full schedule of teaching I have little time myself either for research or for directing the research of others. Lafayette College, through President John H. MacCracken, has agreed to give me practically my entire time for research, provided that $3,600 a year can be secured for the employment of another man to carry the elementary teaching, which is now a part of my work. The college will of course furnish the laboratory space, equipment, etc.

Several firms have shown interest in the work on plasticity and have offered to coöperate in a variety of ways, which prompts me to write this letter. From the nature of the work in which you are engaged, I believe that you are interested from a practical point of view in seeing our knowledge in this new field greatly amplified, just as the writer is from a scientific point of view.

My own interest in this work is such that I agree to give $1,200, which is one-third of the whole amount required, out of my own salary, and I only regret that I cannot do more. Perhaps, however, even this will indicate good faith.

In case we can raise $3,600 for the year 1922–23 the entire time of one man will be devoted to research and its direction.

It is proposed to make a study of the fundamental problems of viscous and plastic flow, and it is hoped that the results may be applicable to all colloid problems and not limited to problems of flow in a single industry. The results of the research will be made available through publication.

Will you or your firm share in establishing this fund for research in plasticity for the year 1922–23?

Respectfully yours,

(Signed) EUGENE C. BINGHAM

Chairman of Lafayette College Research Committee

COÖPERATIVE RESEARCH[1]

The Advisory Council in their Seventh Annual Report to the Privy Council for Scientific and Industrial Research tells of the research organizations and of the work being accomplished in England. We wish it were possible for every member of the Society to have a copy of this report because of the inspiration for coöperative research with which it teems. We quote here only a few paragraphs covering the objects and methods under their system of coördinated government and industrial supported research.

"The problem before the country, as we see it, is to provide a means which will enable its population of nearly 50,000,000 to live and prosper. It is well recognized that for four-fifths of their food and for a great part of the necessary raw and semi-manufactured materials for industry, the people of these islands are dependent on supplies from overseas. These supplies can only be obtained if this country is able to carry on its exporting industries in future with greater efficiency than the rest of the world, for it is doubtful whether we can compete, either by lowering wages beyond the limits of our competitors, or by securing a much greater human effort than they. If these two avenues are closed, competition, in the end, is confined to greater efficiency resulting from scientific work, for, in the long run, our outstanding business skill and organisation could not make good a deficiency of production or an obvious inferiority in our goods. We consider that scientific and industrial research, along the lines which

[1] Extracts from Report of the Committee of the Privy Council for Scientific and Industrial Research for the Year 1921–22, England.

we have laid down and on which we have been building during the past seven years, is an essential factor in the national effort on which the continued maintenance of our present population unquestionably depends."

"The utmost use must be made of the natural resources we possess, and at each stage through which our raw materials pass in their evolution from the natural state to the most highly finished product, the utmost efficiency of the machinery employed and the human skill applied must be secured if we are to succeed. The fullest utilisation of the discoveries and methods of science, through close association with industrial effort, alone can ensure the achievement of this end."

Research Associations

"Twenty-four research associations have received licenses from the Board of Trade and twenty-two of these are in active operation. In addition, three other industries have the possibility of forming such organisations under immediate consideration and research associations are likely to be launched in these cases in the near future. Preliminary negotiations are taking place with several other industries.

"Of the twenty-two associations referred to above, two have at the date of this report just passed into their fifth year of grant aid and four others have commenced their fourth year; nine associations are in their third year and seven are in their second year.

"When the Government scheme for industrial research was started it was thought that a period of five years would give reasonable time for an industry to test and try the value of coöperative research; for this reason the offer of grant assistance was made for a quinquennium in each case. The scheme cannot be described as an experiment in the value of research as applied to industry, for long before the scheme was instituted a number of firms possessed successful research laboratories; no experiment was needed to prove to these the value of scientific research. But privately organized and financed laboratories were only for the wealthy corporations; the smaller firm could not hope to face the outlay and the annual charges involved, however much it might be convinced of the utility.

"There are many indications that the industrial world is tending to move from an age of pure competition between firm and firm to one in which the element of competition will be merged in emulative coöperation. The scheme is in general consonance with this tendency, though the success of the movement as a whole may only be partial, and actual failure may occur in individual instances, for the economic conditions which have prevailed during recent years have been exceptional and have put obstacles of a most formidable type in the way. For this reason the five-year period has been a less effective test of the ultimate usefulness of coöperative research than it would have been under more normal conditions. In any case, five years is no lavish space in which to set on foot an institution, to equip it with men and material appropriate for its purpose, and to produce results sufficient in value to prove the worth of the undertaking.

"Experience has shown that the best part of two years is required before the organisation can be said to have got into its stride and to be in a position to attack its problems. If in the following three years some results of value emerge, then there will be justification for the State's educational endeavor and for the faith of the pioneers in the various industries to whom the movement owes so much. That results of value will come sooner or later we have no shadow of doubt, but we trust that, if in certain instances they do not come sooner, the particular industry and its upholders will not give up hope. When times are bad and every item of expenditure has to be narrowly scanned, the subscription to a research association which has not yet produced tangible results may seem to be an addition to the budget of dubious value, even though it

may be no more than a workman's or foreman's wage for the year. The cost of supporting research cannot indeed be justified by comparing it with the prime cost of production—especially when demands are falling off—but by the consideration that it is the means of improving and cheapening production and, in consequence, of increasing the demand. Research, as we have often pointed out, is a cost in the same category as insurance. It is an insurance against the effects of ignorance with the certainty, if it is wisely undertaken, of large and continuous bonuses."

COÖPERATION

"We have said that the Government scheme of aid to industrial research is an educational venture. It is experimental in the sense that it is an attempt to establish coöperative research in this country, and the experiment has been opportune. At the very moment when private industrial research organisations have found it necessary to diminish their expenditure and, consequently, to curtail their activities, established research associations, with a guaranteed income during their first five years of existence, have been given the certainty of being able to arrange their programmes without fear of drastic economies during that period. No coördinated scheme of work can be devised and followed unless an assured and sufficient income is available for its prosecution. A staff, however devoted, cannot be expected to give single-minded attention to their work if they are anxious as to their future for reasons in no way connected with their efficiency.

"Coöperation is the essence of the scheme and every year shows fresh directions in which team work in the widest sense can serve a useful purpose. Firms of varying size and financial strength can pool their resources according to their standing and can enjoy the results which that partnership secures. To the smaller firms this is of particular value for, otherwise, research work and the expense it involves would not be within their powers. Team work within an association is also of the first importance. A research worker thrown among a number of his fellows with whom he can confer, compare notes, and consult, has more chance of producing results than he would have in the isolation, or in the comparative isolation, of a smaller organisation, especially when he has the advantage of serving under a chief with wide vision and experience.

"During the past year, fresh evidence of the value of coöperation has been forthcoming in other directions. In several instances, two or more research associations have found it profitable to join forces in attacking some common problem, realising that each can supply something of use to the other to their mutual advantage. Thus the British Cast Iron Research Association and the British Refractories Research Association are joining forces in investigating sands and refractories. The Research Association of British Motor and Allied Manufacturers and the British Cast Iron Research Association are jointly dealing with the casting of cylinders, while the important subject of die-castings is being approached by the Research Association of British Motor and Allied Manufacturers, the British Non-Ferrous Metals Research Association, the British Scientific Instrument Research Association and the British Electrical and Allied Industries Research Association, in collaboration. Again, the Glass Research Association and the British Refractories Research Association have joined in an investigation into the refractories used in the glass industry. Further coöperation between research associations and various Government departments has been found possible and mutually beneficial.

"Thus it is that the scheme, which was designed primarily with the object of coöperative endeavour on the part of individual firms in the same industry, is becoming the means of bringing still larger interests together for a common purpose. This principle is likely to prove a prominent factor in organised industrial research of the future. The raw material in one industry is the finished product in another; it must be to their

common advantage for the makers of the two to come together. We have discussed elsewhere the conditions under which it is possible to combine producers and users in a single research association and these necessary conditions are not often found to be present. But although the producer is better able to conduct researches for the development of more economic processes or improved products than is the user, he often needs the necessary stimulus. The Gas Companies desire gas stoves to be more economical because they realize that while the consumption of their product would be less per stove, the number of users would be vastly increased. But, because the consumers were unorganised, it took the Gas Companies a long time to discover this simple truth. Research associations bring about an organised criticism of the product used in their industry and thus lead the way to improved production by the manufacturers of the materials they use. Coöperation between a research association of producers and a similar association of users thus becomes simple and natural within the limits of their common interests. Many examples of this tendency could be cited and the principle was clearly before the eyes of the Government in founding the scheme, for it expressly provided means for coöperation between different research associations in attacking specific problems."

HEADQUARTERS OF RESEARCH ASSOCIATIONS

"Some research associations have their own laboratories, some rent suitable accommodation from universities or other public institutions, and some delegate the whole of their work to experts engaged in universities or elsewhere. There is evidence that, wherever possible, it is advantageous to an association to have its own research station. The advantage lies not only in the concentration of a staff and their research work under the eye of the Director, but in the fact that the existence of the research station stimulates the interest of the members of the association. If a member can enter a research institute created by the association of which he is a supporter, he feels a sense of ownership and a keener interest in its work. This interest is essential to the permanent success of the undertaking. Moreover, when Government grants cease at the end of the quinquennial period, the existence of a fully equipped research establishment will be a further incentive to the members to see that its continued maintenance is not jeopardized by lack of funds. The good will of a research association will be larger in the case of an association in possession of its own headquarters than in the case of one which has conducted purely extra-mural operations.

"Research associations have proceeded in the matter of headquarters along different lines. The British Cotton Industry Research Association has an annual income at present of about 20,000 pounds a year; in addition it received a large grant from the Trustees of the Cotton Trade War Memorial Fund. With funds of this order behind it, and with over 90 per cent of the firms in the whole industry members of the Association, the Council was in a position to acquire and equip premises on a large scale. The Shirley Institute, as the headquarters of the Association is called, consists of a large mansion standing in $14^1/_2$ acres of freehold land. The house has been fitted up to provide accommodation for a library and information bureau, a council chamber, refractory and administrative offices and residential accommodation for certain members of the staff. In the grounds have been erected up-to-date and well-equipped laboratories on the most modern principles; in addition, there is a series of workshops for the construction and repair of instruments used in the laboratories and for the general maintenance of the Institute. In another part of the ground eleven houses have been erected for the use of married members of the staff.

"The British Cotton Industry Research Association has been honoured by a visit from H. R. H. the Duke of York, K. G., who declared the Shirley Institute open on March 28, 1922. We realize that by this gracious act His Royal Highness has conferred the

benefit of Public recognition not only on the British Cotton Industry Research Association but on the movement for industrial research as a whole.

"Less wealthy associations have had perforce to content themselves with less ambitious homes but several have acquired properties which have been adapted to provide commodious and convenient laboratories. The Linen Industry Research Association has acquired a large house standing in 22 acres of ground which is almost as impressive as the Shirley Institute, the laboratories in this case being provided in the house itself. The British Research Association for the Woolen and Worsted Industries and the British Portland Cement Research Association also own substantial establishments.

"In several cases, for example, the British Scientific Instrument Research Association, the Glass Research Association, the Research Association of British Rubber and Tire Manufacturers, the British Association of Research for Cocoa, Chocolate, Sugar, Confectionery, and Jam Trades, private residences in London or the suburbs have been acquired and adapted with excellent results. A private residence of the proper size can be converted at a relatively low cost into a convenient and efficient research establishment. Private houses, with large basements but of substantial size and structure, can now be acquired at reasonable prices owing to the disfavour into which residences of this type have fallen. But the inconveniences which they present for domestic use are no serious drawback from an association's point of view. The despised basement lends itself, as a rule to the installation of apparatus requiring solid foundations,the capacious living rooms, with their large window space, are admirably adapted for laboratories, and where the house stands in grounds of its own, facilities can be provided for physical recreation. There is much to be said for making the conditions under which research is carried out as congenial as possible.

"The associations with small incomes at their command cannot aspire to separate headquarters and, in such cases, accommodation has been sought at university or other public institutions, where equipped laboratories are leased at a rent which includes the provision of gas, electricity and water. With a modest income this course is far wiser than more ambitious projects which may result in "Overbuilding." The cost of upkeep of the headquarters is a first charge on the resources of the association and, as time goes on, it does not diminish: as a result, the essential research work may suffer. There is a natural temptation to acquire what appears at first sight to be a bargain in the estate market, but a home which entails an undue amount of expense in the future is no more a bargain to a corporate body than it is to the private individual."

Nature of Research Undertaken by Associations

"In previous reports we have directed attention to the nature of the work undertaken by associations and have laid some stress on the importance of fundamental research as compared with work directed to the removal of immediate and practical difficulties. We hold the view that it is no part of the function of an association to undertake work which normally falls to the consulting chemist or physicist, or to the consultant called in to advise on difficulties in connection with a works 'lay out.' On the other hand, an association, especially in its early years when the confidence and support of the industry are being enlisted, may well feel disposed to allow its staff to undertake subsidiary investigations requiring great experience and knowledge for their completion, although they are not of the widest application. The staffs of several associations have successfully coped with difficulties of this kind and as a result have gained immediately the confidence and trust of their members. But these efforts have rightly been regarded as a secondary function and have not been conducted to the exclusion of the larger issues. These can only be solved by getting down to fundamentals.

"There is indeed little basic difference between the fundamental research work required by industry and academic scientific research sometimes styled 'pure' research.

The real difference is one of stimulus. The general tendency in 'pure' research is to follow the train of thought of greatest scientific interest by pursuing the problem initially selected through all the ramifications which may present themselves, or at least through all those which interest the investigator. The phenomena investigated and the taste of the research worker are, in most cases, the only directive forces. In industrial research, on the other hand, the aim is more definitely objective; the work has a distinct purpose in view which the investigator must bear in mind constantly. He cannot afford to follow attractive by-paths unless he believes they will lead him to a relevant destination.

"The problems of industry draw attention to gaps in scientific knowledge which it is essentially the duty of the industrial researcher to fill. The acquisition of such knowledge may be called fundamental research as applied to industry for, without it, far-reaching changes and improvements in industry are almost impossible. Thus it is that the British Cotton Industry Research Association finds it necessary to study the properties of single cotton fibres and the chemical constitution of the cellulose molecule. The British Photographic Research Association is occupied in investigating the fundamental properties of silver haloids and the physico-chemical properties of gelatin and similar colloids. The British Portland Cement Research Association is endeavoring to ascertain the exact chemical nature of the compounds constituting Portland Cement. It was only by an elaborate investigation of the primary phenomena of abrasion and polishing that the British Scientific Instrument Research Association was able to perfect the abrasives and polishing powders which are now proving of such industrial importance. In all such cases the research worker has ever before his mind the necessity of bringing his investigation to a practical issue.

"We have been led to make observations because we have found some evidence recently of a good deal of misconception in the distinction popularly drawn between 'industrial' and 'pure' research. There is undoubtedly some ground for this attitude in the loose use by industrialists and company promoters of the word 'research' to describe experiment by trial and error and in the attempts often made to solve complex industrial problems on the full scale without any adequate preparation for the passage from the laboratory to works production. The wise manufacturer knows better than this and the man of science supports him. But we maintain that the distinction between fundamental industrial research and 'pure' research lies primarily in the source from which the impulse to its conduct is derived. We desire rather to emphasise *the essential unity of all genuine research; its stimulus may come from different* sources; its applications may be various; but its outlook, its spirit, its methods are one."

DR. S. W. STRATTON RESIGNS FROM DIRECTORSHIP

Becomes President of Massachusetts Institute of Technology

With the resignation of Dr. Stratton as director of the Bureau of Standards, the American Ceramic Society undoubtedly loses its best and most influential friend in the scientific departments of the government. As head of the only government Bureau which has had a regular appropriation for ceramic investigations over a period of years, he has shown such an insight into and appreciation of the needs of the ceramic industry that all who have gone to him personally with problems have come away feeling that he understood the question and would keep in direct contact with it.

The Bureau of Standards secured its first fund for ceramic investigation in 1910, when the Technologic Branch of the Geological Survey was merged into it. The amount appropriated was a mere pittance—it would not now pay the annual gas bill which the

Bureau incurs in its investigations. Dr. Stratton, by his insistent efforts with Congress, has been able to impress it with the urgent need of more funds, so that by the end of the war the amounts available for the work at the Bureau amounted to about $70,000 annually. By his continued efforts since then, he has prevailed upon Congress not to curtail this fund, even though it was very materially reducing appropriations to all Bureaus annually. Dr. Stratton knew from personal contact that now especially was the need for more funds, even more so than at any other time in the history of the industry, if the lead held in so many lines during the war were to be maintained.

S. W. Stratton

During the past four years he was able to obtain practically a new plant for the Ceramic Division. The old cramped, totally inadequate quarters in Pittsburgh were abandoned and several suites of rooms on three floors in a new structure were especially designed and equipped with the most up to date equipment. In the new quarters at Washington the space devoted to kilns and furnaces alone exceeds the entire space available at Pittsburgh before the war. With the removal of the plant to Washington the employees felt the enthusiasm and interest of Dr. Stratton in their work more than ever, as evidenced to them through his almost daily visits to the laboratory when not out of the city. This he did although the Ceramic Division was but one of eleven divisions and occupied part of one of seven large buildings, for all of which Dr. Stratton has secured appropriations from Congress.

The best wishes of his many friends in the American Ceramic Society go with him to his new duties as President of the Massachusetts Institute of Technology. We believe he will carry on his interest in the ceramic industry, for his close contacts cannot be broken off abruptly. What event could betoken more for the development of the technical side of the ceramic industry than to hear that a well-designed course in ceramic engineering would be inaugurated at that institution as a result of his connection there? In any case those who may take their ceramic problems to the newly established Research department of M.I.T. in the future will know that its president realizes the importance of the problem and will be exerting himself anew in a field in which he is already well acquainted.

U. S. BUREAU OF STANDARDS PURSUES ENAMEL INVESTIGATION

Some preliminary tests have been conducted by the Bureau of Standards in a study of the causes of specking of ground coat enamels. This specking appears as spots of oxide and slag in the enamel coating, a condition which appears to be due to excessive local rusting of the steel previous to the firing of the enamel.

Preliminary tests have been made on steel cups furnished by a manufacturer of such articles and coated with regular stock enamels. The results of the test indicate that the rusting and subsequent specking are due to an excess of acid or salts in the enamel. The defect has been remedied by the addition of sufficient sodium hydroxide

to the enamel previous to the dipping operation. Since this defect is a serious one in the production of white enamel ware, it will probably be advisable to continue this investigation in order to go into the subject more thoroughly.

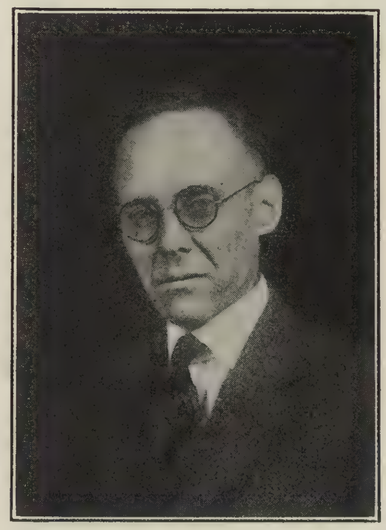
G. A. BOLE IS MADE SUPERINTENDENT OF CERAMIC EXPERIMENT STATION

Mr. G. A. Bole has been appointed Superintendent of the Ceramic Experiment Station, U. S. Bureau of Mines, at Columbus, Ohio, to succeed Mr. R. T. Stull who was advanced to the position of Supervising Ceramist last April.

Mr. Bole has efficiently served as Acting Superintendent for six months prior to his appointment as Superintendent. He came to the Bureau in August 1921 from the New York State School of Ceramics, at Alfred, New York, where he was for nine years head of the department of chemistry. Under his supervision were developed strong courses in physical chemistry as applied to ceramics, as well as courses in industrial fuels which included heat balances on power plants and ceramic kilns.

His work since coming to the Bureau has consisted principally of control work in connection with the industrial kiln investigation. Together with Mr. F. G. Jackson, he has been studying the oxidation of ceramic ware during firing.

The Bureau is at present carrying on industrial coöperative work with more than a dozen industrial concerns, as well as maintaining an efficient laboratory staff and laboratory car.



G. A. Bole

Mr. Ellsworth Ogden has been appointed ceramic engineer with the U. S. Bureau of Mines. Mr. Ogden's work will consist largely of field work. He comes to the Bureau with a wealth of ceramic engineering experience. Mr. Ogden's appointment was made upon the recommendation of Colonel Orton, Mr. Bleininger, and Mr. Purdy.

REPORTS OF INVESTIGATIONS BUREAU OF MINES

Production of Alumina from Clay Tests on the Miguet Process

By Clyde E. Williams (Metallurgist and Superintendent, Northwest Experiment Station, Bureau of Mines), and Clarence E. Simms (Electrometallurgist, Bureau of Mines)

In recent years much interest has been centered on the possibility of producing alumina from clay, and proposed methods for the recovery of alumina are appearing constantly in parent literature. As a good grade of clay contains from 30 to 40 per cent of alumina, the prospect of recovering it is alluring, although obviously difficult.

A patent typical of many projected thermal processes is that of Paul Miguet (U. S. Patent No. 1,376,563) entitled "Process for the preparation of pure alkaline aluminates."

He proposes to prepare alkaline aluminate by fusing clay, lime, and scrap iron with a reducing agent in the electric furnace thereby reducing the silica and forming calcium aluminate and ferrosilicon. The calcium aluminate, being lighter, would float on top substantially free from foreign oxides. It could then be tapped off, cooled, and later crushed and leached with sodium carbonate solution to form, by double decomposition: sodium aluminate, and calcium carbonate. The former is soluble and yields readily aluminum hydroxide. The ferrosilicon would be recovered as such and sold at a profit. The reactions are supposedly as follows:

(1) $Al_2O_3 . 2SiO_2 . 2H_2O + Fe + 4C + CaO - FeSi_2 + 4CO + CaO . Al_2O_3 + 2H_2O.$

(2) $CaO . Al_2O_3 + Na_2CO_3 - CaCO_3 + Na_2O . Al_2O_3.$

So many reactions similar to the above have been proposed, and it is so popularly believed that alumina can be obtained from clay by fusion, that the Northwest experiment station of the Bureau of Mines at Seattle, Wash., undertook to investigate the Miguet process.

The tests were carried out in a carbon-lined pit furnace of the Girod type having a tap hole to remove the fused material. Clay containing 38 per cent alumina pure air-slaked lime, steel turnings, and gas-retort carbon were used. These materials were finely ground, intimately mixed, wetted, and dried in lumps to avoid dust.

In the first tests the charges were made up with clay, lime, iron, and carbon in theoretical proportions according to the Miguet patent. The charge melted down readily and when melted was tapped. The analysis showed only a slight reduction of silica, and it was thought that possibly insufficient time had been allowed for reduction. The test was therefore repeated, the charge being held molten for a considerable time before tapping. No increase was noted in the amount of silica reduced. When the product was crushed and leached with a hot concentrated solution of sodium carbonate, only a trace of alumina and fully as much ferrous iron was found in solution.

When the proportion of lime was increased, it merely increased the melting point and gave no better product. In these first tests an effort was made to keep within the limits of commercial practicability, but having failed to obtain any favorable results, these restrictions were cast aside and tests were made to determine what was technically possible. The proportion of lime, carbon, and iron to clay was increased to speed up their action on the clay, and the charge after fusion was heated to 1800°C and held for 30 minutes. Still results were unsatisfactory. A charge was then made up with carbon three times and iron twice the theoretical quantity. The purpose was to subject the charge to the most intense reducing conditions possible, and silica is known to reduce more readily in the presence of iron. The charge was melted with the furnace over-powered to such an extent that dense fumes arose. The production obtained was black and stony—hard enough to scratch glass easily. On examination, it was found to contain carbides of calcium, aluminum, and silicon, sillimanite, and quantities of a glassy substance. The analysis showed that about 40 per cent of the silicon had been reduced and alloyed with the iron. The product of this final fusion, when leached with sodium carbonate, gave a recovery of about 30 per cent of the alumina. This alumina produced contained 0.6 per cent SiO_2.

The fact that alumina was actually produced gives some small basis for the claims of the patent, but the prospects of its successful applications are extremely poor. In the first place, to produce alumina by the method of the most favorable test, the cost of the material alone would be more than $300 per ton, as the minimum figure. Moreover, there is no proof that calcium aluminate was formed, because, with so much carbide present, it is just as likely that the sodium aluminate obtained was formed by the decomposition of aluminum carbide and its subsequent solution in the sodium carbonate.

It is certain, too, that silica is not alone in being acted on by the carbon, but that all the other oxides will also be reduced in varying degrees.—*Reports of Investigations, U. S. Bureau of Mines.*

U. S. BUREAU OF MINES CONSULTANT

Mr. W. D. Richardson has accepted an appointment as consultant with the Ceramic Experiment Station, United States Bureau of Mines, Columbus, Ohio. His services are to be utilized in connection with the industrial kiln investigations being carried out by the Bureau.

Mr. Richardson was graduated from Colgate University with the degree of A.B. in 1879 and received his A.M. degree in 1884. Until 1887 he was located with the Columbia School of Mines and for two years he assisted in the chemical laboratory of Dr. Thomas O'Connor Sloane. Three years more were spent in Minnesota manufacturing face brick, then after a short time in St. Louis he located in Ohio. Since that time Mr. Richardson has been managing brick plants and engaged in general consulting practice, designing and building plants. He is best known as a designer of kilns. He was President of the American Ceramic Society in 1906–1907 and continues as a contributor to the technical literature on kilns and kiln burning.

CALENDAR OF CONVENTIONS

American Association of Ice & Refrigeration—Washington, D. C., Probably March 1923.
American Association of Museums—Charleston, S. C., May, 1923.
AMERICAN CERAMIC SOCIETY—Pittsburgh, Pa., Feb. 12–16, 1923.
American Concrete Institute—Cincinnati, Ohio, Jan. 22–25, 1923.
American Engineering Standards Comm.—29 W. 39th St., New York City, Dec. 14, 1922.
American Face Brick Association—West Baden, Ind., Dec. 5–7, 1922.
American Foundrymen's Association—Date not determined.
American Institute of Mining and Metallurgical Engineers—New York City, Feb. 19–22, 1923.
American Malleable Castings Assn.—Cleveland, Ohio, Jan. 9–10, 1923.
American Metric Association—Boston, Mass., Dec. 30, 1922.
American Society of Mechanical Engineers—New York City, Dec. 4–8, 1922.
American Society of Refrigerating Engrs.—New York City, Dec. 4–6, 1922.
American Society for Testing Materials—Place not determined, June 1, 1923.
American Zinc Institute—St. Louis, Mo. or Atlantic City, N. J., First or second Monday in May, 1923.
Association of Scientific Apparatus Makers of the United States of America—Bureau of Standards, Washington, D. C., April 20, 1923.
Canadian National Clay Products Association and Western Ontario Clay Workers Association—Hamilton, Ont., January 24–26, 1923.
Chamber of Commerce of the U. S. A.—Place not determined, Week of May 7, 1923.
International Chamber of Commerce—Rome, Italy, Week of March 19, 1923.
Clay Products Association—Chicago, Ill., Third Tuesday each month.
Common Brick Mfrs. Association of America—Cleveland, Ohio, Week of Feb. 5, 1923.
Dental Manufacturers Club—St. Louis, Mo., November 20, 1922.
Dental Exhibit of the Dental Manufacturers Club—St. Louis, Mo., November 21–24, 1922.

Federated American Engineering Societies—Place not determined, Date not determined.

Manufacturing Chemists Association—New York City, June, 1923.

Mining and Metallurgical Society of America—New York City, December 7–13, 1922.

National Association of Mfrs. of Pressed & Blown Glassware—Pittsburgh, Pa., March 13, 1923.

National Association of Mfrs. of U. S.—New York City, Week of May 14, 1923.

National Association of Stove Mfrs.—Richmond, Va., May 9, 1923.

National Association of Window Glass Mfrs.—Place not determined, Date not determined.

National Association Builders Board of Control—Des Moines, Iowa, February 1923.

National Bottle Mfrs. Association—Atlantic City, N. J., Last of April, 1923.

National Brick Mfrs. Association—Cleveland Ohio, Week of Feb. 5, 1923.

National Canners Association—Atlantic City, N. J., Week of Jan. 22, 1923.

National Exposition of Power and Mechanical Engineering—New York City, December 7–13, 1922.

National Gas Association of America—Loiusville, Ky., Spring, 1923.

National Jewelers Board of Trade—New York City, January 18, 1923.

National Paving Brick Mfrs. Assn.—Place not determined, Date not determined.

National Society for Vocational Education—Detroit, Mich., November 30–December 2, 1922.

Portland Cement Association—Chicago, Ill., November 20–22, 1922.

Refractories Manufacturers Assn.—White Sulphur Springs, W. Va., Nov. 2–3.

Sanitary Potters Association—Pittsburgh, Pa., Monthly Meetings.

Stoker Mfrs. Association—Hot Springs, Va., November 21–23, 1922 (fall meeting) May or June, 1923 (annual). Place not determined.

Taylor Society—New York City, November 23–25, 1922.

Tile Manufacturers Credit Assn.—Beaver Falls, Pa., Quarterly Meetings.

U. S. Potters Association—Probably Washington, D. C., December 10, 1922.

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BULLETIN
of the
American Ceramic Society

A Monthly Publication Devoted to Proceedings
of the Society, Discussions of Plant Problems, Discussions
of Technical and Scientific Questions and
Promotion of Coöperative Research

Edited by the Secretary of the Society Assisted by Officers of the Industrial Divisions

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Vol. 1 December, 1922 No. 12

EDITORIAL

INDIVIDUALISM vs. COÖPERATION

The time is within the memories of many living when man was very much more dependent on hand labor in all things, and when traveling, even across town, was tedious and news was carried mostly by couriers. Under these circumstances there was very little of collective labor and practically no industrial coöperation. In comparison with the present there was, one or two generations ago, very little mutual dependency of man industrially. But with the possibilities and necessities of men working in organized groups brought about by machinery and process inventions, men became more and more dependent upon their fellows.

The affairs of man are becoming more complex with each passing year making more pronounced this mutual dependency. This is reflected in the many and increasing numbers of commissions appointed to adjust affairs between capital and labor. The prosperities and adversities of one state in the Union are shared by all to an increasing degree with each passing year. The prosperities and adversities of the "Far East," of Russia and of all lands are reflected in the affairs of this country to a greater and greater extent each succeeding year. Mutual dependency is becoming more evident.

Displacement of hand labor by machine methods has brought the industries from the home shops into factories and the more rapid and dependable means of communication have caused the individual factories to combine into still larger industrial groups. The side hill coke ovens

and lime kilns of individual farmers are now rarities if not wholly extinct and the small hand brick yard is an economic impossibility. In spite of our natural aversion to the "wicked combines" and to the "large financial interests," these must be recognized as legitimate products of the increasing complex industrial conditions. They are the inevitable results of big machinery and improved methods giving larger production.

Trade and technical associations, industrial research laboratories, federal bureaus, semi-public research institutes, research councils of each industrial nation and the more recent international councils are not fads but are the natural means suggested by the increased complexity of industrial affairs which in turn calls for organized coöperation.

The consequences of attempts to eradicate "trusts" and "big financial interests" by resolving the industries back to the state of individualism are to be seen in Russia. Communism that involves the dissolution of stock companies, big or little, has always resulted in demoralization. Coöperation of concerns through Associations is the only communism that will meet the requirements brought about by the modern equipment and methods for manufacturing and transportation.

Continued industrial prosperity will require either larger "combines" and more of them or more intimate coöperation through associations. Failure to support these associations is a failure to provide the means of manufacturing by concerns of relatively small capitalization.

The American Ceramic Society gives the opportunity for organized coöperation of ceramic industries to promote their technical, scientific and artistic welfare. Next February in Pittsburgh recognition will be given to the foresightedness of that group of twenty-one pioneers, who, under the leadership of Professor Edward Orton, Jr., twenty-five years ago organized this ceramic technical and scientific Society.

Ceramic industries are *coöperating in technical* and scientific research much more today than heretofore but there is yet a great deal of harmful prejudice against the sharing of information. The ceramic industries have not yet reached the stage where several concerns will pool their scientific knowledge of materials, mixtures and processes as do some of the concerns in other industries.

It is the policy of this Society to preach and to practice coöperation in things technical, scientific and artistic. When the conventions of trade associations and associations of users of ceramic products, and when the trade papers and journals are filled with reports of researches on ceramic problems, this Society will have realized the ideal. It is to this end that we are working.

Individualism in industrial, scientific and artistic ceramics is essential but to a larger degree today than at any time past there is need for more intimate coöperation.

DISCUSSION[1] ON "BEST TYPE OF CROWNS TO BE USED OVER GLASS TANKS"

MR. KNOTHE:—There is apparently no certain answer or solution at present to the question of the best type of crowns to be used over glass tanks. The suggestion of using a flat crown under the furnace has been made several times. Often the opinion has been advanced that a tank furnace is too large a unit for that type of construction to be feasible. From a mechanical standpoint it is entirely practicable to build a flat crown on a furnace.

MR. HOSTETTER, CHAIRMAN:—You have had experience or some suggestions along that line?

MR. KNOTHE:—We have worked up a design for that type of furnace. It has not been tried out yet, and I am not in a position to say what can be expected but it is believed that the furnace can be built and made practical from a mechanical point of view.

MR. CRUIKSHANK:—The Murphy Iron Works have used the flat type of arch in the furnaces under boilers. They use rectangular blocks provided with tee-headed slots in their upper surface by means of which they can be suspended by bolts to beams running across the furnace. The design is patented by them. The device has been very successfully used in boiler furnaces as it confines the heat as well as brings the top of the furnaces closer to the boiler tubes and thus economizes space. Another decided advantage is the facility for renewing anyone of the blocks. The only difficulty I can see in the use of such a cover over melting furnaces is that there would be a tendency for the joints to open, whereas with the ordinary arch held by buckstaves the brick are held tight together and there is no possibility of leakage of gases through the crown. With the suspended flat blocks the arch effect is done away with.

THE CHAIRMAN:—The flat arch would have one advantage, that of a smaller surface to radiate. What other advantages would you suggest that it would have?

MR. KNOTHE:—A flat arch could be repaired in spots without disturbing any of the rest of the arch.

DISCUSSION[2] ON "ABSTRACTING AND PUBLISHING DATA OF VALUE FOR GLASS-RESEARCH LABORATORIES"

MR. HOSTETTER:—This subject is listed in the program as "Possibilities of Having Records of Each Industrial Glass-Research Laboratory Systematically Examined with View to Abstracting Data of Value and Publishing the Same." The National Research Council is collecting data of that type wherever possible to secure it and we have had requests from

[1] Glass Division, St. Louis Meeting, Feb. 1922.

[2] Glass Division, St. Louis Meeting, Feb., 1922.

the Council along this line. It is a question of getting time to dig through the files and get it out for them. I think it is a desirable thing that if we can get fundamental data from the research laboratories dealing with these questions, to get that material in form available for the industry. Probably those of you in laboratories from glass houses around the country have had similar requests from the National Research Council. In connection with research in glass I would like to call your attention to a report in the Year Book of the American Ceramic Society, in which the Committee on Coöperative Research, Glass Division of the American Ceramic Society, in the National Research Council, have proposed subjects for research on Glass Technology proper: (1) *Physical Properties of Glass:* Viscosity of molten glass, especially factory methods for determination; surface tension of molten glass, especially factory methods for determination; density of molten glass, especially factory methods for determination; (2) *Chemical Studies on Glass:* Correlation of physical properties with composition; reactions taking place in glass manufacture, with especial reference to the rate of evolution of gas; gases dissolved in glass; effect of temperature and duration of fining; effect of chemical composition; development of colored glasses; manufacturing problems; correlation of fining temperatures with physical properties; study of methods of furnace control, such as devices for measurement of temperature, of velocity of gas, air rate and completeness of combustion; (3) *Problems of Furnace Construction (Refractories):* improved material for tank walls; effect of special cements and coatings on furnace and tank life and efficiency; furnace and tank design.

This is submitted without much comment, and it would be helpful indeed if we could get laboratories equipped for doing this work such as the Bureau of Standards and Mellon Institute to set about this in a systematic manner, and get at some of these problems. If other companies were to establish industrial fellowships as Corning Glass Works has with Doctor Washburn at a cost of a thousand dollars per annum, half-time service, they would soon make fast strides in really knowing why and how to do certain things.

DISCUSSION ON "WHY ARE OPEN POTS USED IN EUROPE AND NOT IN THE U. S.?"[1]

MR. HOSTETTER, CHAIRMAN:—The question of "Why Are Open Pots Used in Europe and not in the United States?" My impression was that we use in this country both open and closed pots. Yesterday Mr. Bellamy cited literature to the effect that it was impracticable to lay glass in contact with flames in open pots. When we started to make optical glass in this country we were very much worried about making dense

[1] Glass Division, St. Louis Meeting, Feb., 1922.

flint glass in open pots. We finally got up to lead glass, 55% lead oxide in open pots, and in the course of melting hundreds of pots of glass, containing about 45% oxide I have never seen indications due to the reduction of lead. Occasionally a water cooler would break and get some metal in the pot such as a chunk of iron, but no discoloration as far as we could work out took place from the reduction of lead by the flames. Has anyone experience along similar lines?

Mr. Wright:—I have talked to a few glass-makers who came from foreign countries, and they have often spoken of open pots in the furnaces, where they fill in the pots and melt over night, and the following day cool down the furnace and work from those pots. They were making a periodic operation either every day or every other day from these furnaces. In this country most of the glass furnaces maintain a melting heat all the time so that when the glass pot is filled in and finally melted the pot glass can be moved by removing the stopper without reducing the temperature of the melting unit.

Mr. Forsyth:—I would like to have you ask Dr. Hess what he knows on the subject, especially about the practice in Holland in melting in these open pots.

Dr. Hess:—England, Holland and Germany use small open pots on lead glass. The matter of open pots for lead glass depends very much on the size of the pot and the area. It is perfectly feasible to melt lead glass in open pots with absolute success. In optical glass, for instance, up to a definite size you have found that that could be done; and in the early days on the bulb machines we were trying to work tanks on lead glass. We had some very interesting and peculiar results. Quite frequently we would get a very good glass. We were working by hand at that time the same as if we were working in the pots now and sometimes we would get a run of beautiful glass for an hour or two. Often, however, for a half-day, a half-month or a month we would not get glass that was clear. The greatest trouble there seemed to be the flowing of the different densities of glass over the surface of the tank. The glass of a lighter specific gravity would flow over the top, and it would pull with it the heavier glass from the bottom. It might be that a device inserted into the tank for stirring might help matters. We have done some experimental work along these lines and found we could handle it, but it has not been wholly satisfactory. In relation to the open pots, it is a question of a different system of working. They work at one time and melt at another; they make their melt over night, and work in the daytime. But they work much smaller pots than we do and they find it impossible to work and melt at the same time. There is no question but that a great deal of work can be done on the closed pots if proper conditions of flame and temperature are developed. You have to be exceptionally careful and not have a tem-

perature raise while working lead glass. A temperature raise always gives trouble. You have all heard that you could not make ruby glass in tanks, but that is an exploded theory. I have also seen people make ruby glass in pots and seal the pot so thoroughly that it has blown the crown off by reason of the accumulated gas pressure. I do not think there is any difficulty in making ruby glass in tanks or lead glass in open pots but when you come to a certain size definite mechanical features must be introduced.

THE CHAIRMAN:—Are these gold rubies or selenium rubies?

DR. HESS:—Both gold and selenium rubies.

MR. WRIGHT:—I would like to raise a question here on ruby glass. Dr. Hess made a statement about causing the gas to press out through the crown. Was that the pressure of gases?

DR. HESS:—That was a case of there being no escape for the gas. It was simply a condition developed on the part of the caretaker of the furnace.

MR. WRIGHT:—Do they not retain a certain quantity of those gases which are lost in the tank?

DR. HESS:—I produced the same color from the same batch in both tank and closed pot. Faster melting seemed to give me better results from the slower melting.

THE CHAIRMAN:—Mr. Bellamy, what rubies did you melt in that small tank?

MR. BELLAMY:—Gold rubies only.

MR. HOSTETTER:—I do not know of any furnace in existence in this country of the circular type in which open pots are used. Does anyone know of any European styles that are in existence in this country? It may be that investigation will show there is a real economy in getting quicker melts and lowering them the next day. Certainly with the open pot you secure much more rapid melting than in the covered pot.

DR. HESS:—I think in a great many cases they have not used an open pot entirely. A removable cover was used such as we had in the crown of the pot. This was removed to facilitate the melting and during working time closed up, so that the flame would not blow in on the surface of the glass. This is necessary when working and melting at the same time.

MR. HOSTETTER:—I have used those. They work out all right.

MR. FORSYTH:—In talking with some men from Holland who operated the open pot, they brought up the point that in working out these open pots, it was very much hotter than working out of the closed pots; and that our workmen might perhaps raise some objection on that point.

MR. HOSTETTER:—No doubt they would in this country.

MR. GRAFTON:—The only place that I know where they work the open pots in colored glass is in the Johnson Glass Company of Hartford

City, Indiana. They have a small furnace containing four pots, a burner in the center radiating heat, and flues in each corner of the furnace built on the style of a pot arch. I cannot give you very much information in regard to the furnace but anyone interested in the subject, could write to George Fulton of Hartford City, Indiana. I am sure he will give you the information you desire regarding the melting in open pots.

DISCUSSION[1] ON "GLASS CONTAINERS"[2]

MR. WILLIAMS:—The Glass Containers' Association has started a Fellowship at the Bureau of Standards and we have one man working. I have given a great deal of time and attention to that work myself. The problem which we thought would be the most interesting to the greatest number of the glass manufacturers was some scheme for preventing the weathering or scumming on the ware in storage, which causes considerable loss to everyone. We are also working on the properties of glass with respect to use for food-packing and canning, to be used in place of the tin can containers. It is desirable to get a method and apparatus more suitable to the physical properties of glass.

MR. HOSTETTER:—Mr. Williams evidently has been dealing with some glasses that are very unstable. I think all of us have had experience at times with glass and know the troubles we have had with them before we could ship them to our customers. The stability of glass is a very important field for investigation. Aside from this, however, there are many problems involved in the manufacture and use of glass containers, for instance, the packing of carbonate water. We have there the possible action by CO_2. Dr. Bitting has told me that ginger ale was packed in glass and shipped to distributing points. The breakage in transportation to the distributing points was very small. After six weeks' storage the breakage had increased greatly as compared with the first breakage, due presumably to the fact that the glass was subjected to fatigue, having, been exposed for this period of time to high internal pressure of carbon dioxide. The work of the Containers' Association of which Dr. Bitting is Director of Research is extremely important and this Division should certainly work in close coöperation with them wherever possible.

The question of the strength of glass stability in contact with foods of various kinds, as well as the weathering in the air are matters to be considered.

Mr. Williams showed pictures[3] of some milk bottles that were weathered

[1] Glass Division, St. Louis Meeting, Feb., 1922.

[2] Bitting, *Jour. Amer. Ceram. Soc.*, **5**, 85 (1922); Ford, *ibid.*, **5**, 837 (1922).

[3] See Williams, "Disintegration of Soda Lime Glasses in Water," *ibid.*, **5**, 504 (1922).

very badly. The statement was made that the average life of a milk bottle was something like five trips.

MR. FORSYTH:—Three.

MR. HOSTETTER:—Mr. Forsyth says it is three trips but five is the lowest number I had been informed of.

MR. WILLIAMS:—The National Dairymen's Association, as far as they have gone, show that the life of a milk bottle is thirty days.

MR. FORSYTH:—My only information was the statement made during the milk controversy in Cleveland by one of the largest milk concerns there. It might have been a little advertising policy. I asked one dairyman about it. It is only one case and not an average case. He said they averaged eight trips.

MR. HOSTETTER:—It is surprisingly low, whether it is three or eight. We certainly ought to develop glass that would stand up a longer period than that.

MR. WILLIAMS:—You cannot blame that all on rough handling of the dealer and the user; sterilization of the bottles and sudden heating in the winter time affect the life of the bottle. I have been in dairies where they were washing bottles and noticed incipient cracks, very small and hardly noticeable when the bottles are cold. Those bottles are naturally weakened and the second time they are washed the crush grows a little more although the final break may come in handling. Milk bottles are very strong and will stand quite a blow when they are new, but glass seems to suffer from fatigue as much as metal and the breakdown is not altogether due to the rough handling.

MR. YUNG:—The glass companies have quite a job on their hands if they are going to combat the work of the Glass Container people themselves, for they are having quite a campaign now. Every paper that comes out fosters the use of glass containers. Not long ago, I read a paper where they advised the glass people to smash all the bottles they could get their hands on. They went so far as to advise all their traveling men and anybody connected with the industry to ask in the hotels for all the condiments, such as catsup, in bottles so as to create a greater amount of breakage, by having them handled oftener. It seems to me we should have something to make the bottle stand up, if they are working another combination for destruction.

MR. HOSTETTER:—Has anybody any knowledge as to the relation between "weathering" and "strain" in the glass? Is strained glass more subject to corrosion than glass properly annealed.

MR. YUNG:—Some work done on case-hardening may help on that. The straining of the glass showed something to the effect that the glass container or dish which was case-hardened was less attacked than one which was annealed and the weathering that was shown was by the cutting

of the external surface. A case-hardened piece of glass has a surface under intense compression, and it seems that that compressed surface is more resistant to corrosion than that with a cut or broken surface underneath.

MR. HOSTETTER:—Would you go so far as to say that if you had a surface in tension it would be attacked more rapidly than one in compression? Would you say that there was any degree of strain, positive or negative?

MR. YUNG:—I do not know that it necessarily was a compression of the surface. The experiments were not carried out far enough.

MR. HOSTETTER:—The plate glass people, for instance, maintain that their glass as cast is more resisting than after it has been ground and polished.

MR. FULTON:—I think they are right in that.

MR. BROWN:—I can state positively that glass which has been ground after it has been cast has nothing like the resistance to weathering like glass as cast.

MR. WILLIAMS:—In our numerous tests by treating glass in boiling water or in an autoclave the original glass surface is always more resistant to corrosion than merely fractured edges or ground surfaces. Whether these surfaces are in compression or tension, I do not know, but I do believe that they are in equilibrium with the interior.

MR. GOODMAN:—I should like to know if anyone has any formation on the subject of the weathering of glass. In opening up some large glasses that were packed in cartons, there were corrugations formed, a white film on the glass. Is there anything on the cardboard that would cause that to be affected with these corrugations?

MR. PAYNE:—We have noticed this several times and have found it was just from the warehouse, or coming from the paper, but we are not familiar with the actual markings of weathering where the ware was in contact with paper.

MR. WILLIAMS:—Was that the marking on the exterior of the bottle or interior?

MR. GOODMAN:—The entire glass had a white film and could be seen along where the bottle and the article touched the corrugations. You could see the corrugated marks.

MR. WILLIAMS:—It is very rare indeed to see scumming on the exterior of a container. It is always on the interior where the evaporation goes on much slower. That is the reason for it. Those corrugations might have been dust and dirt. Did you try to wash them off?

MR. GOODMAN:—Yes.

MR. WILLIAMS:—Then it was probably the weathering.

MR. GOODMAN:—We have noticed that in taking some articles and putting them outside of the cardboard cartons, nothing happens to them, but

when we place them in the carton and leave them there a while we see the corrugation marks on the glass.

Mr. Brown:—The question of weathering bottles resolves itself into one similar to any other kind of a question of glass: that is the question of moisture. CO_2 moisture apparently has no effect, and in these bottles, I have seen a case where the ridge itself absorbed the moisture.

Mr. Williams:—When you make a survey of the weathering proposition, you will find all types of soda lime glass from the highest to the lowest, affected with the phenomena of scumming in storage. Therefore, in trying to find the method of obviating the occurrence of this it looks as though it might be a proposition of trying to avoid scumming by getting the right method of storage rather than correcting the composition since we have it in plate glass and window glass, and also in all types of bottles. Consequently, it may occur in glasses having a wide variety in composition under certain conditions of storage.

Mr. Hostetter:—Unfortunately we cannot always have the storage facilities desired. I am reminded of the remark of Mr. Dixon in regard to the stability of glass when salt cake is used in the batch. Glass of the crown type can retain in solution considerable proportions of both chloride and sulphate, and perhaps the presence of the sulphate acts as a stabilizer to some extent.

There is an interesting thing in connection with weathering that occurs in glass used in lampworking. Glass that has stood around for many years will have a weathered film over the surface. When this glass is heated in a blow-pipe flame it cracks very readily. There are two means of avoiding this difficulty: One is to dry, wash off the weathered film on the glass with hydrofluoric acid and the second is to introduce sodium vapor into the flame which in turn will act on this surface film and restore it to the original condition.

Mr. Brown:—Does that idea hold as well on boricsilicate as sodium lime?

Mr. Hostetter:—I can't tell you that. Mr. Forsyth says to some extent it will work.

DISCUSSION ON "FINE OR COARSE-GROUND MIXTURES FOR CHECKER BRICK IN GLASS FURNACES"[1]

Mr. Zopfi:—I know nothing about this subject from practical experience, but it occurred to me that there might have been some of the members who have conducted an investigation along these lines, on whether fine ground checker brick, due to its structure will absorb and give off heat more rapidly than a coarse-ground brick.

[1] Glass Division, St. Louis Meeting, Feb., 1922.

Mr. Hostetter:—The spacing of bricks in checkers is highly important. It has not been given sufficient consideration in furnace design. Heat transfusion is a function of the velocity of the gas and that in turn depends upon the spacing of the checkers and the pressure under which the furnace is operated. That end of it has received some consideration, but the question of the texture of the actual brick in the checkers is before us now.

Mr. Zopfi:—The impression I had in reference to checker brick has been that a great many glass manufacturers insist that the checker brick be a very coarse-ground mixture with the idea that heat will penetrate very much more rapidly and give off more rapidly than will the fine-ground brick. We are inclined to question this, though we have had no actual demonstration in a glass house checker. A glass melting pot of fine texture will melt quicker than one of coarse grain and for that reason we believe that the checker brick of fine-grain clay mix is better than the coarse grain.

A Member:—Is there any differentiation between the density due to vitrification and density due to finer-grained mixtures, *i. e.*, is the dense texture which you have in mind due to the mixture of grog and clay, or to the degree of vitrification or to both?

Mr. Zopfi:—I would say that the density was due to both the degree of vitrification and size of grog, but the density or structure due to amount and size of grog would be the most important.

Mr. Fulton:—I have no knowledge of any tests covering the subject brought up by Mr. Zopfi, but it has been the general practice to use coarse-grained brick for checkers. The reason held for this is that a coarse open texture brick will withstand repeated heating and cooling and will have less tendency to spall than a brick of fine dense texture.

Mr. Hostetter:—That is true unless they were made out of zirconium silicate.

Mr. Brown:—That has been my experience too.

Mr. Forsyth:—It looks to me as if there has been no actual demonstration of the fact that the dense brick would spall under those conditions. After old checker brick are well glazed and rendered fairly dense we have noticed spalling.

Mr. Fulton:—I know of one experiment where silica brick was used for the top courses of the checkers in an effort to prevent the collection of dust at this location. In this respect the experiment was a success but the fluxes carried into the checkers attacked the silica brick very rapidly and after a very short period more than half of each brick was washed away. While silica brick has a strong tendency to spall, these brick when removed showed a dense glazed surface and there was no evidence of spalling.

DISCUSSION ON "THE INFLUENCE OF HEAT ON THE MICROSCOPIC PROPERTIES OF SILICA IN ITS DIFFERENT MINERAL FORMS"[1]

By Herbert Insley:—Mr. Robson's article is apparently based on the assumption that there is a gradual change from one polymorphic modification of SiO_2 to another, *i. e.*, that the physical properties of quartz change gradually when it inverts to tridymite or cristobalite and that the process of inversion can be stopped at an intermediate point and there the physical properties such as index of refraction will be found intermediate between those of the two crystalline modifications. Such a conception of the mechanics of polymorphic change is contrary, as far as I know, to any modern theories.

Table II in Mr. Robson's article gives the index of refraction of quartz as 1.545 before heating and as 1.517 after heating to cone 14. The author explains this change in the following sentence: "No effect is noticed in the case of either sand or quartz on the index at cone 13, about 1390°C, but at cone 14, about 1410°C, a decided drop has taken place in the indices of both substances, showing that above cone 13 both sand and quartz tend to transform into cristobalite, which has an index of refraction of 1.487." The above statement seems to imply that 1.517 is the index of refraction of a pure homogeneous crystalline modification of SiO_2 with physical properties between those of quartz and cristobalite.

Unfortunately the methods of examination were not given in detail, but it seems probable that the particles examined microscopically after heating to determine the index of refraction were not homogeneous but were intimate mixtures of quartz and cristobalite which gave values for the index of refraction somewhere between the true values of quartz and cristobalite. If this is the case it is dangerous to base estimates of the percentage of the whole sample inverted to cristobalite on the index of refraction of single aggregates which very probably are not representative of the sample.

The conclusion reached by the author, "that French flint and chalcedony both transform into cristobalite before sand and quartz," may be true but the article under discussion does not prove it for the conception of the mechanics of crystalline transformation on which the conclusion is based is not the generally accepted one and has not been proved.

Mineral Forms

By Mr. Robson:—In answer to Mr. Insley's discussion the writer wishes to state that he is of the opinion that there is a gradual change in the aggregate from one polymorphic modification of SiO_2 to another.

[1] J. T. Robson, *Jour. Amer. Ceram. Soc.*, **5,** 670 (1922).

Of course there is not a gradual change from one form to another in the discrete particles of the aggregate, as is well known, but all the discrete particles do not transform at the same time and hence the aggregate mass which is what is seen under the microscope will be made up of changed and unchanged discrete particles which altogether will give this aggregate an intermediate index of refraction such as claimed by the author. This phenomena of gradual polymorphic transformation of the aggregate is shown by Spotts McDowell[1] where he gives a table showing the effect of repeated burning upon the constitution of silica brick. A portion of this table illustrating this gradual change follows:

Mineral	Number of burns 1	3
	Volume per cent	
Quartz (and silicates)	25	12
Cristobalite	71	58
Tridymite	4	30

Note the decrease in the volume of quartz after the third burn, likewise the variation in volume of cristobalite and tridymite.

In our laboratory we have a sample of sand which has gone through the glost kiln of a tile plant. When immersed in oil of 1.545 index (that of quartz) this sample has high relief, when immersed in any other oil as 1.487 index (that of cristobalite) the grains still have high relief. This is explained by the fact that a thin skin or shell of cristobalite has formed on the outside of the quartz and when immersed in oil of 1.545 index the cristobalite shows then and *vice versa,* when placed in oil of 1.487 index, the quartz causes a high relief in the oil so that the cristobalite cannot be determined.

However, when these grains are crushed in a mortar, the cristobalite shell index and quartz index can be determined readily.

In reply to Mr. Insley's statement, "It is dangerous to lose estimates of the percentage of the whole sample inverted to cristobalite on the index of refraction of single aggregates which very probably are not representative of the sample," I would call attention to the statement by Posnjok and Merwin.

By calculating as nearly as possible the volumes of the various impurities and assuming the additive relations for refractive index, the calculated mean refractive indices for several analyzed specimens have been found. Comparison of them with the observed values is found in Table IV.

In view of the above prescribed mode of precedure by these authorities, the writer feels absolutely justified in drawing the conclusions to which Mr. Insley objects.

[1] "A Study of Silica Refractories," *Trans. Amer. Inst. Mining Eng.*, **57,** 43 (1918).

TABLE IV

No.	Mean refractive index, calculated from analyses	Mean refractive index, measured
9	2.28_6	2.30
10	2.27_2	2.28
13	2.22_5	2.21
14	2.22_2	2.19
15	2.20_2	2.19
16	2.17_8	2.17
17	2.16_8	2.17
18	2.11_7	2.12

The writer wishes to make it clear that he does not claim that there is a pure homogeneous crystalline modification of silica with physical properties between those of quartz and cristobalite as Mr. Insley infers but that the aggregates do have an index corresponding to the mean indices of the discrete particles of which it is constituted.

The writer also believes that the conclusion reached that French flint and chalcedony both completely transform into cristobalite before sand and quartz is correct.

DISCUSSION[1] OF "ITEMS OF COST FREQUENTLY OVERLOOKED"[2]

MR. D. F. STEVENS:—For several years, most of the heavy clay products industries have alternatingly experienced a condition of no business, or so much business that costs did not make very much difference, but we are now probably in a period of considerable duration in which costs are going to become of vital importance.

There will be increasing demands for brick and tile but not a sufficient demand for a long time to come to absorb the full capacity production. Therefore the manufacturer who has his costs under the best control and is most accurate is going to have a great advantage over one who has an inadequate record of his costs.

Emphasis is often placed on the various items of expense but to arrive at a cost rate, we must have not only the items of expense but also the quantity of ware produced by which to divide these expense items and thus obtain the rate. That is where a great many men are deceiving themselves.

The total amount of green ware produced at the machine is often considered as the production of the plant, and the various items of expense are divided by this figure. As a matter of fact even before the ware is on the dryer cars there is a certain amount of damage which would result either in off-grade ware or absolutely unsalable ware. Such items of

[1] Heavy Clay Products Division, St. Louis Meeting, Feb., 1922.

[2] Owens, *Jour. Amer. Ceram. Soc.*, **5** (Bull. Sec.), 48, 1922.

loss pyramid in geometrical ratio if not itemized at each stage through the process. Very few plants make any particular effort to determine the loss and depreciation in manufactured ware as it progresses through the factory.

It is practically impossible to operate a dryer of any type without a certain amount of ware coming through damaged. Some of this will be rejected by the setters but some will be set.

Many face-brick manufacturers keep account of the number of damaged brick coming back to the machine for a short time. If the conditions remain constant so that the same amount of damaged ware will be returned each day, a constant percentage can be used in the cost determination and the manufacturer can do without the daily records of damaged ware. But the amount of ware thus returned is usually not constant. In our own case it varies to a certain extent with weather conditions and more with the conditions of our raw material. Different parts of the vein will produce more brick loss than others. We decided that it would pay to keep an exact record on every damaged brick at each stage in the manufacture, with statement of the cause.

In the case of face brick each car is a unit, hence it is easy from day to day to determine just exactly what our dryer loss is. After the ware is set, burned and drawn, we obtain records of kiln losses.

Mr. Farnham spoke of the fact that with piece work many times there will be no loss shown whatever and that there will be more good ware coming out of the kilns than was set. We operate our plant on piece work, and I know that this condition is painfully true. The only accurate way to avoid this is to count the cullage when the kilns are cleaned. If you do not want to count each individual brick, the number of wheelbarrows could be used.

In piling the ware in the yard and later when loading it, a certain amount of loss will occur which should be known.

These various leaks, each one not very great, over a period of time amount to a great sum. The total of these losses should be deducted from the machine count of the ware produced to arrive at the proper divisor to be used in determining cost rates.

Another factor of even greater importance is the loss through off-grades. Many manufacturers do not stop to consider that their off-grade ware must be sold at a small fraction of the production cost although the cost of production is just as much. It has required the same amount of fuel, labor and overhead and yet must be disposed of at a very low price, and in many cases must go to the dump. The first-grade ware must carry the loss incident to the manufacture and sale of the off-grade ware.

The most convenient and satisfactory way to arrive at a selling price for first-grade ware is to carry all off-grade ware at a low inventory rate

and then charge the difference between this and the cost of production for the period under consideration against your first-grade ware. That, of course, will materially increase the cost of your first-grade ware, but you will know that you are selling your first grade at a profit and taking care of the loss which otherwise you would incur in the sale of your off-grade ware.

I believe this is the simplest and the surest accounting system. From the standpoint of income tax returns it is the safest because it automatically carries the inventory at a deflated figure.

These two particular lines of expense, (1) loss in broken and defective ware coming through the various processes of manufacture and, (2) the off-grade ware which has to be sold at a very much less price, are frequently overlooked. Manufacturers who do not take these losses into account will think they are operating at a profit whereas actually they may be operating at a very considerable loss.

A Member:—How many bricks do you put on a car, Mr. Stevens?

Mr. Stevens:—We average about 500.

A Member:—Do you carry any extra brick to make up for the loss of the breakage?

Mr. Stevens:—I think the actual count of our brick is 504, and we carry the cars as 500, but we keep track of the actual loss at each stage.

A Member:—We figure about 600 for the car and put on 16 extra brick. All of the breakage from the kiln is collected and weighed. We have a hopper on the return tracks to the machine in which we weigh the bricks damaged prior to burning. When we empty the kilns we clean out and weigh the waste.

Mr. Stevens:—If you are making all your product the same weight, weighing is just as well as an actual count.

Mr. W. H. Herbert (Nashville):—A short while ago I asked the transfer man to give me an accurate count of the number of broken brick on a certain number of cars. I checked this up with him and found he was turning in the number of bads as the number of brick; he had twice as many bads as he had of brick.

Mr. Stevens:—The Indiana white labor on the whole have that same degree of mentality. It is pretty hard to check them up by a count. Our records at the end of the year will be out about 200,000 brick.

Mr. Langworthy:—We do the same thing. Our cars hold about 500, but they fall short of that because the machine fellows are on piece work so we count 470 to the car although it figures a little bit more than this. We make seventy cars for 33,000 brick.

We also keep track of the number of bricks broken in the dryer. We call it the dryer loss, but we do not take that into account because at

the end of the year we have about 200,000 extra brick on the plant to inventory.

A MEMBER:—We do not; that 30 brick on a car covers all of our loss—the dryer loss and the kiln loss also.

MR. STEVENS:—That will run about 6%.

MR. LANGWORTHY:—But we set those extra brick. The machine men make the extra brick and the setters set them and the drawers draw them.

MR. W. H. HERBERT:—We manufacture dry pressed brick. We had a revolving counter on the machine, counting the number of bricks the machine made. As we had to assume the loss, we finally gave that up and now we count the actual bricks that go to the kiln.

MR. STEVENS:—How do you count the bricks?

MR. HERBERT:—We have a board set up near the truck. This pushes a lever which operates a counter.

MR. STEVENS:—I was talking to a manufacturer recently who told me of a friend who wanted to get the exact count to prevent the men from cheating, and they installed a checking device so that when the car loaded with ware went over this section of the track, it rang a little bell and made a record in the office.

The manager happened to be in the office one day and heard the bell ring. A very short time after that he heard it ring again, and he did not see how in the world they could have filled another car that quickly so he slipped out to the machine room and around behind the door and listened. The car was run through and then in a very short while a fellow hit this device with a sledge which would positively ring and mark up another car. That is one serious disadvantage in having the machine room on a piece work basis.

We tried that for several years and had to give it up and went back to day work because of the tendency to slight, if not actually to miscount, and at least to put defective ware on the cars. Once you get your defective ware on the dryer cars it is very difficult to eliminate them afterwards. They will be put into the kiln and share with the good brick the expense of burning and the cost of space occupied. With day work this is not so likely to happen. We are making a rather high-grade ware, and the question of quality is vital, so in our case day work makes our machine-room cost a little bit higher.

We have a monthly bonus which we give the machine-room men for steady working which does not depend on any particular day's run. This gives them an incentive to stay on the job and keep things going in good shape. Problems of that sort vary with individual conditions.

MR. POTTS:—Do you put holes in your bricks?

MR. STEVENS:—Yes.

MR. POTTS:—Three or two?

Mr. Stevens:—Two, about $1^1/_8$ inches apart. Of course, the number of holes and their spacing would vary with the clay; some clay will stand an inch and a half hole, and others will not stand an inch. Recently we changed to two holes instead of three to decrease the breakage.

Whether it is a peculiarity of our material or not, I do not know, but with two holes we get less breakage than with three smaller ones. It is true that the brick will not break half as easy with two holes.

Mr. Greer:—There is one question that seems to me fundamental, and that is the unit basis for cost figuring, whether it should be the ton or thousands of brick.

It seems to me that the ton basis is the only definite basis of costs. It is the only factor that can be applied against ware of all varieties, particularly heavy bricks.

Mr. Stevens:—I think there is a good deal to what Mr. Greer says about costs varying practically in direct proportion with the weight.

We make two different styles of rough face, and one of smooth face and the weight will vary somewhat, but the various items of cost, with the possible exception of fuel, are not in proportion to the weight at all, but are in proportion to the number of bricks produced. In other words, some of our bricks that weigh about $4^1/_2$ pounds will actually cost us practically as much as a brick that weighs about 5 pounds, and the same thing is true with our floor tile. The smallest size of floor tile is 3″ x 6″, and the largest is 6″ x 9″.

The 4″ x 4″ tile involves just as much handling and just as much expense, with the possible exception of fuel, as the 6″ x 9″ tile, hence we found it was more convenient to just count the number of individual units. I can very readily see that in the case of heavier ware, such as sewer pipe and drain tile, the tonnage basis would be better.

Mr. Potts:—I always prefer a tonnage basis, because it is the only common medium. If you are making a line of drain tile from 4 to 12 inches, and a line of fire proofing up to 12 by 12 inches, you can have no other means of comparison than on the tonnage basis.

Mr. Amos:—I do not know that I can agree with either of these gentlemen. I am operating two plants combined. The shale goes to one set of bins for hollow tile and another set of bins for brick. We figure our brick costs by the thousand and, as Mr. Stevens says, the weight of the bricks makes no difference in their cost of manufacturing. You can make brick of four or of five pounds and a half, just about as cheap as you can make a brick that is smaller.

Of course, in making paving blocks, weighing eight pounds, there would be quite a difference in that cost, but as long as there is very little difference in the bulk of the brick, the difference in the weight of the brick makes practically no difference in the cost, except as to fuel.

Large, heavy brick, as a rule, will cost a little more to burn than a smaller, lighter brick. In our hollow tile plant we figure costs on the ton basis, and the service rendered to both plants in the shale pits and the power is divided between the two on a tonnage basis.

MR. TEFFT:—We make quite a few shape brick, and anything under the size of a standard brick is given a standard brick equivalent, we call it S. B. E. unit. Anything over that in a shape is given whatever the volume would be, of one and a third, one and a half or possibly two. We make some brick that would be large enough to take even a six S. B. E.

MR. DAILEY:—There is no doubt but that the question of keeping an accurate record of the production of the various departments is just as essential as accuracy in our books of account. No matter how careful we are, discrepancies will appear in our records of machine-run ware dried and set, and ware drawn from the kilns. Our aim though, is to keep these discrepancies as low as is practicable without a too burdensome system of checking. We keep our production record for these different departments by days and months and we also keep a record of each kiln showing the input and output. Just as soon as any differences other than reasonable ones occur we immediately set about correcting them.

A manufacturer considered he was producing 5,000 tons of ware per month in his plant. As a matter of fact he was producing at the machine 5,000 tons, but the total tons of No. 1 ware drawn from his kilns was materially less. We consider the output at our plant as the tons of No. 1 ware wheeled from our kilns.

I might say that we would have no faith in a cost system that was not interwoven with our regular books of account. We keep an accurate distribution of our expenses and go into it quite thoroughly by carrying a ledger account for each sub-divided item of expense for each department. As an example, our pit expenses are divided into the following, each of which has its own ledger account: pit labor, pit fuel, pit repairs and pit supplies. The total expenses shown on our cost sheets as the total of these accounts is then figured against the production of the pit in tons of ware giving of course the cost per ton. So on through our entire plant each department has from four to one dozen accounts. The departments consist of pit, machine room, drying, transferring and setting, burning, and drawing. Next comes factory overhead, or as we term it "indirect." Our overhead expenses, separated as to selling, office and miscellaneous are sub-divided just as carefully as our factory manufacturing costs are. We not only arrive at cost figures monthly but by carrying cumulative totals of our distribution as figured against cumulative production totals we have an average cost figure that is an item that I would particularly like to call your attention to.

In an industry subject to as wide fluctuations as the heavy clay products

industry is, if each manufacturer arrived at his costs carefully on an average basis as mentioned, there would certainly be a far more satisfactory condition within the industry. These averages, or cumulative figures, can be taken over a period of six months or a year, or of course it would be an ideal condition if the trade would start in and keep their average costs over an indefinite period. I would like to add that I firmly believe that selling costs should be averaged over a like period and I earnestly advise the industry to compare their average selling costs with their average manufacturing costs.

I think this covers briefly our views as to cost accounting with particular attention called to (1) the advisability of careful counting of ware for our production records, (2) the fact that No. 1 ware only taken from our kilns is what we count as production from our plant, and (3) the importance that we advise the industry to attach to cumulative or average cost figures. Ample depletion and depreciation charges are made on our books of account and since our accounting system is a part of our cost system, depletion and depreciation are of course considered in our costs.

MR. STEVENS:—Do you include interest on the investment?

MR. DAILEY:—We do not include interest on the investment as a part of our cost expense.

MR. GREENOUGH:—What have you got to say about depreciation on plants operating at less than full capacity?

MR. DAILEY:—We charge that at the same rate as we would have charged had we been running full time.

MR. GREENOUGH:—Suppose you were only running 50%, would you charge the full amount?

MR. DAILEY:—We charge the full amount just the same. I have gone on the assumption that a plant depreciates just about as rapidly running on part time as it does running on full time, or at full capacity. Possibly a reasonable exception could be taken to this although I would have to be convinced. Running at 50% capacity as compared to full capacity would of course make a depletion charge for depletion of raw material just 50% of what it would be were we running at full capacity.

Most of our work throughout our plant is on a piece-work basis and once in a long while we find that either due to an error or wilfully, our records for the output of the department will be off. With close supervision, however, these are promptly detected and if we have a reasonable doubt as to its having been a wilful miscount we do not hesitate in adjusting the record, and in some cases this adjustment almost amounts to a penalty. I can assure you that after we make these adjustments it is several months, or close to a year before the same thing is repeated. In fact the labor gang has to change almost entirely. In our plant the employees in the different departments for the most part do their own tallying and counting. Stand-

ard loading of dryer cars for each size of ware is pretty closely adhered to. Holding that the setters in our case are entitled to pay for ware rejected, we believe that this course insures as careful inspection by the setters as it is possible for us to get.

This cost system has been working for years and the longer it is in use, it follows that the more valuable it becomes to you because of the information you have accumulated for comparison.

Mr. Child:—Whenever we get into this subject of costs, I am reminded always of a little incident that happened in Pittsburgh a few years ago.

An old Irishman had built up quite a large business. He didn't know anything about costs, and very little about accounting. He was one of those drivers that had started with nothing and had gotten several boats under his control, running from Pittsburgh down the Ohio River.

One day after they had made quite an extensive trip, he said to his bookkeeper: "Well, how much did we make on this trip?" The bookkeeper said: "Well, I am sorry I haven't got my books closed yet. I haven't got my balances."

The old fellow stood and looked at him a minute and he said: "Got your bills all paid?" The bookkeeper said "Yes." Then the old fellow said: "How much money have you left?"

I often think of that when we get to talking about costs and the greatest fallacy in cost accounting is the fact that so many firms try to put in an accounting system without tying together their general cost and their manufacturing costs per ton or per thousand. Thus over a period of five or six months they might show a profit compared with their costs but be out of line with the net profits shown when they close their books. Often there has been a tremendous loss some place along the line that they haven't taken into consideration.

We ran along for about three years, trying to keep a very itemized cost account in which every employee had a time slip. The time slip was checked at night, showing the number of hours employed on each job. The hours for each job were charged against a certain account. We are now manufacturing drain and hollow tile in sizes from 3″ to 27″, inclusive. We take our total expense for the month, based on the sales journal, We do not take consideration of our No. 2 tile or cull tile; we figure that the No. 1 tile sold has to carry the load of our entire production. Therefore, if our records show that 2500 tons were manufactured in the month, and our inventories and sales show 2300 tons a month, we have lost some place in the operation 200 tons. Therefore, the 2300 tons a month must carry the full burden of all costs.

We have never worked out a satisfactory cost for each size of tile and I don't know of anybody else who has.

We all know that the loss on a four- or five-inch tile compared to the

loss of 27″ tile amounts from 25 to 35%, but I do not see how a tile plant can work on any other basis than by the ton.

I was very much interested a few days ago when I heard Mr. Wills, who was on the Federal Reserve Board of the Cleveland District, say that the next three years would probably be the most highly competitive that this country has ever experienced. I feel that this year the selling price will be quite largely determined by the other fellow, but your own cost price is determined by yourself and nobody else, and I think that during the next two or three years the men who make a success in the heavier lines of clay products will be the fellows who spend the major portion of their energy on reducing costs, rather than on sales. I have never seen a time in my life when it was a price market so much as it is today and I think it is going to continue that way for some time.

Mr. Dailey:—Our cost system is entirely tied up with our books of account. Each subdivision of our departments has a ledger account, and it is just as much a part of our books of account to furnish information for the cost system as it is for profit and loss. Whether you count your sales as output or not would be immaterial over a long run; it would average up over a year, but why make one month's profits suffer because you happen to store ware in the yard.

Mr. Amos:—It does not; your difference in your inventories takes care of that, Mr. Dailey. For example, if you make two thousand tons, and you sold 1500 tons for the month, the difference between your inventory the first of the preceding month, and the last of the month would add to that inventory to show that you had gained 500 tons for that month.

We keep a tabulated record of our machine production, a tabulated record of our kiln production, or what goes into the kiln, and a tabulated record of the good material that comes out of the kiln, but when we get down to our cost per ton, it is based on our sales record, because if you take the emptying record, or the drawing record, your stock on the yard would still show another loss that is not accounted for. Everybody has culls that come out of their stock, and if you base it on the sales, or what you actually receive from your sales, you take care of all these shrinkages.

Mr. Greenough:—In other words, you check your production records by deducting shipments from your inventories?

Mr. Amos:—Yes sir.

Mr. Stephens:—In regard to the difficulty of manufacturing both building brick and paving brick, I believe that from our own experience I might be able to say a word appropriate to that. There is as much difference on a tonnage basis, between paving brick and building brick as there is in our case between building brick and floor tile, and we find that it is the most satisfactory and not at all difficult to separate those items of operation which are distinctly different and keep those entirely separate.

For instance, our machining, setting, and drawing of the floor tile is kept entirely separate from the face brick, and the same thing in the case of the paving brick manufacturer. The paving block items should be kept entirely separate from those for the building brick. Then the general items of clay, fuel, power, drying and burning can be pro rated on a tonnage basis very properly, and the little additional effort required in keeping those special items of expense separate will be many times justified by the accurate results which can be obtained, and will not produce the confusion which a tonnage application would have, as for instance, a five pound builder and an eight, nine or ten pound paver, because there are so many items where the labor costs are so different.

MR. TEFFT:—I feel that you cannot go too deeply into finding out what the cost of each different operation of our brick manufacture actually is. You have got to know what your costs are from month to month, from year to year. If you don't know what each item costs, you cannot control them, and the man who sits in the office, or the man in charge of the plant who is not right on the ground, must make definite comparisons. Unless he has a good cost system he cannot do this.

REMARKS FOR DISCUSSION ON SILICA BRICK[1]

BY K. ENDELL:—In regard to the observation of Mr. Greaves-Walker that Findlings quartzite is similar to some found in Illinois and in old material used as Indian weapons, I might remark that chalcedony must not be confused with Findlings quartzite. The characteristic of Findlings quartzite is that it consists partly of chalcedony and partly of coarse grains of quartz crystals inbedded in the chalcedony.

The decrease of Findlings quartzite in Germany is leading to the use in larger and larger quantities of German Silurian quartzite which, in part, is very similar to the Medina and Baraboo quartzite. Most firms at present add about 50% of such quartzite to the Findlings quartzite, while some add about 80%. Occasionally silica brick are made from only such quartzites.

It is worthy of note that, thanks to the special manner of preparation of silica brick from such Silurian quartzites, only cone 14 is used in burning. They usually have a specific gravity of 2.45–2.50. Indeed the steel industry figures on a suitable expansion and allows expansion joints for the later expansion of the bricks. In figuring expansion joints, one can only rely upon the fact that this specific gravity can be guaranteed. It is to be noted that at present no standard exists.

[1] Discussion, *Bulletin, Jour. Amer. Ceram. Soc.*, **1**, 180 (1922); K. Endell, **5**, 209 (1922).

The softening temperatures for silica brick given in my paper (*Jour. Amer. Ceram. Soc.*, **5**, 216 (1922)), as determined in the Steger press, are too low. Before I went to America, I had only made a few determinations with this press and all sources of error, as in temperature measurements, were not sufficiently considered. Above 1450°C the carbon furnace gave off vapors which made the optical temperature measurements uncertain.

Careful experiments on the true softening temperature have shown that the values given are on the average about 100°C too low. I have run about 100 new determinations which gave 1520–1660°C as the softening temperature for standard silica brick. These values agree with those found in America and with some earlier values I had obtained.

Translated by E. N. Bunting

DISCUSSION[1] ON "THE EFFECT OF SOURCES OF PIG IRON UPON THE ENAMELING OF CAST IRON[2]

By E. P. Poste:—The enameling industry pays too little attention to the metal that is being enameled. The past two or three years have seen the beginnings of an appreciation of this fact and it is very promising to see records appearing in the literature and to know of researches being taken up by technical organizations.

With particular reference to the subject of cast iron as a material to be enameled, there are two phases of the matter which should receive consideration: namely, the composition and structure of the iron. By structure is meant the particular manner in which the constituents, more specifically the iron and carbon, enter into combination within the casting. Bearing on the latter point it must be realized that various types of iron undergo different structural changes during the enameling operation, without changes in composition as a whole.

Some enamelers claim that any kind of mechanically good gray iron can be successfully enameled. Others hold that certain definite specifications as to composition give best results. The writer has discussed this matter with a large number of enamelers and the notes available include the following ranges of composition as having been recommended for sanitary ware:

Sulphur	0.07	to	0.09	Silicon	2.20	to	3.00
Phosphorus	.70	to	.80	C. Carbon	.20	to	.40
Manganese	.30	to	.60	G. Carbon	3.00	to	3.30

Another interesting set of compositions has resulted from analysis of

[1] Received Oct. 11, 1922.

[2] M. E. Manson, *Jour. Amer. Ceram. Soc.*, **5**, 806 (1922).

various European irons used in the manufacture of chemical apparatus. They range as follows:

Sulphur	0.05	to	0.10	Silicon	1.70	to	2.70
Phosphorus	.90	to	1.80	C. Carbon	.09	to	.20
Manganese	.30	to	.70	G. Carbon	2.90	to	3.65

The outstanding differences seem to be the higher phosphorus and the lower combined carbon in the foreign iron. The latter point may result from the fact that all the castings involved in the foreign analyses had been enameled, the enameling operation often causing a drop in the combined carbon.

With reference to the differences between southern and northern iron, the writer can offer no comment other than that his experience has been with northern iron entirely and that the type of troubles being studied by the author has not been encountered. The fact that harder, acid-resisting enamels are involved, as compared with the sanitary type, may have a bearing on this situation.

The author passes over slight differences in combined carbon as insignificant. When it is realized that this combined carbon is chemically united with iron as cementite weighing 15 times as much as the carbon involved, and that this cementite is in turn associated with ferrite to form pearlite 7.4 times as heavy as the cementite, it is seen that slight differences in combined carbon really mean quite radical differences in structural composition. As a specific case we will compare 0.10% and 0.30% combined carbon. In the former case there is 1.50% cementite and 11.1% pearlite; in the latter, 4.5% cementite and 33.3% pearlite. These structural compositions are on the basis of a well-annealed iron, a condition quite sure to follow enameling. For a thorough consideration of the various combinations of iron and carbon in cast iron the reader is referred to Chapter 6 of "Howe's Metallography of Steel and Cast Iron."

The author mentions the possibility of the formation of gases in the iron. The whole matter of the form of the graphite plates, penetration of gases, permanent growth of iron on heating and several related subjects cannot be overlooked in a thorough study of the problem. Hatfield in his book "Cast Iron in the Light of Recent Research," particularly in Chapter 10, records some very pertinent information which cannot be discussed here.

The author's micros of the various irons being studied are very interesting. There are two ways of observing the structure of iron. The use of unetched specimens reveals the nature of the graphite present while etching, as has been done in this case, brings out the other structural features, sometimes producing such a complex field that it is more difficult to note the general nature of the iron.

In researches on iron in connection with enameling the writer has encountered two types of blotches in iron. The first has been termed "nesting" of the graphite. It is best observed on an unetched specimen. This structure is not fundamentally changed on heating, as in enameling, unless the graphite plates originally present form the nuclei for the separation of more graphite from the cementite. The other type of blotches is revealed on the etching of certain irons. It is fundamentally a matter of structure other than free graphite. The annealing of the specimen results in the disappearance of the blotching and the production of a fairly uniform field.

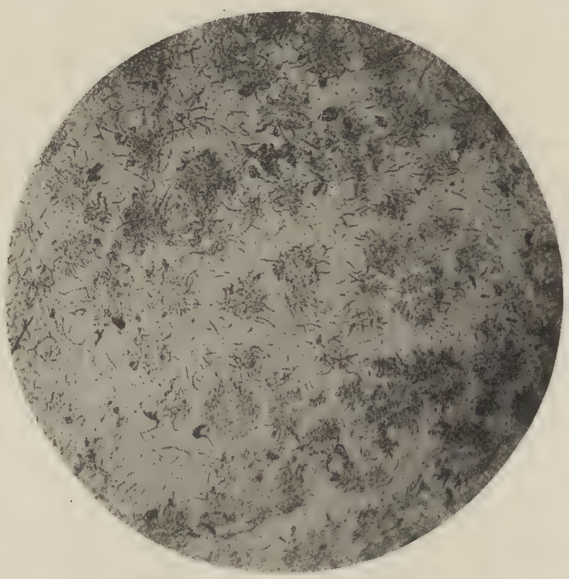

Fig. 1.

The first type of blotching is illustrated by micro No. 1 which is of an unetched specimen of the following iron:

Silicon	1.92	Manganese	0.59
Sulphur	.121	C. Carbon	.90
	Phosphorus	0.69	

This iron showed fundamentally the same structure after annealing.

The second type of blotching is shown in micro No. 2 which is from an etched specimen of the following iron:

Silicon	1.31	Phosphorus	0.39
Sulphur	.063	C. Carbon	.90
Manganese	1.18	G. Carbon	2.94

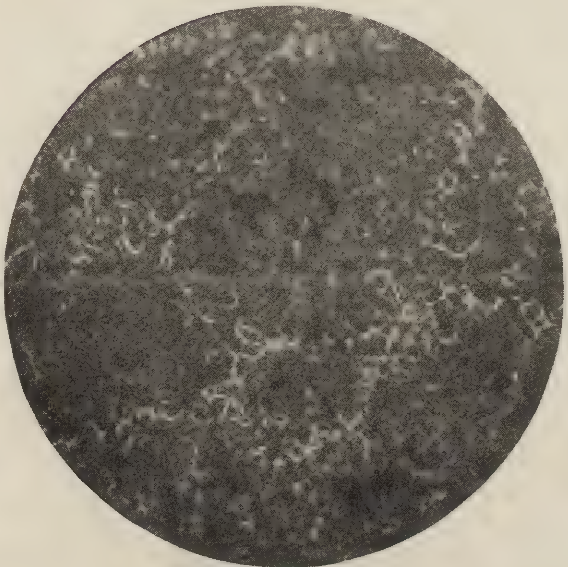

Fig. 2.

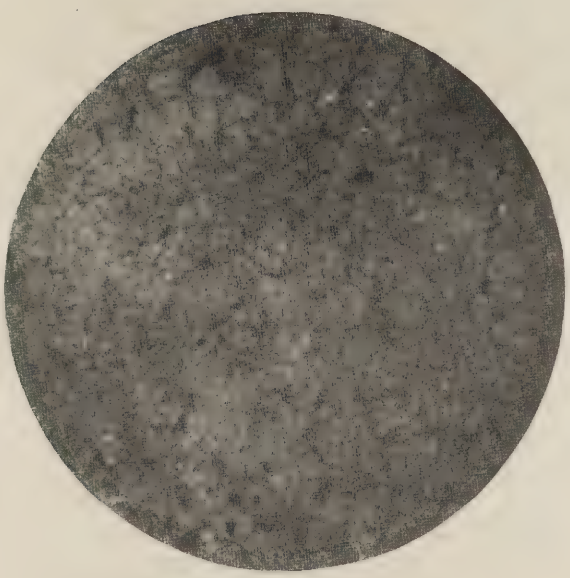

Fig. 3.

This iron after annealing is shown in micro No. 3. Apparently this metal structurally is very close to the eutectic matrix.

The writer is not at all sure that either type of blotching herein illustrated is related to the type presented by the author. But there is possibly a close resemblance between the author's Fig. 9 and the writer's micro No. 2.

If the blotches mentioned by the author are surface blotches, possibly resulting from reaction with the atmosphere through the ground coat, why is it that others do not appear after the surface has been removed by sandblasting exposing a fresh surface for the second enameling? Has the annealing incidental to the first enameling had a part in this?

The writer realizes that this discussion in no way furthers the knowledge of the matter under consideration. Perhaps it will help to bring certain new lines of thought to the problem as it seems to relate to the sanitary enameling industry.

By Homer F. Staley:—In connection with M. E. Manson's paper the following quotations from the "Metallurgy of Cast Iron" by Thos. D. West, 13th Edition, pages 246–7–8, may be of interest.

"An increase in the total carbon, with all other elements remaining fairly constant, increases the life or heat of molten metal, softens the iron, increases deflection and decreases its strength. Where high carbon exists it may cause a kish or scum to rise, which may often be the means of producing dirty or porous castings. Such results can often be remedied by lowering the carbon in mixtures, by the addition of low carbon pig metal or steels, etc."

"Allowing for changes in the percentage of total carbon, the combined carbon varies closely with those of silicon and sulphur, especially the former or, in other words, with a constant total carbon, sulphur, and manganese, etc., the higher the silicon, the lower the combined carbon and the higher the graphite, in normally made and cooled pig iron or castings."

"Very high carbon or silicon can cause metal to be sluggish or thick on the surface, at either the furnace or foundry. Such iron can often be seen evolving a great deal of kish at the furnace, or a scum at the foundry, and makes it very difficult, when in iron, to obtain clean castings.

"To obtain a thin or clean iron and one which will run quickly while it is hot, in making gray castings, use a mixture which will give castings having carbon 3.00 to 3.75, phosphorus .80 to 1.00, manganese .40 to .60, silicon 2.50 to 3.00; sulphur to be below .07. Such an iron, while running thin as long as it retains its heat, could be made softer and have longer life by increasing the carbon and silicon above the limits here shown, but by doing this the thinness, or quicksilver action, would be reduced unless phorphorus was increased, which would be liable to make the castings brittle. The higher the total carbon, the less silicon is required to maintain

the grade and the higher can the carbon be held in a combined or graphitic state, other conditions being equal."

In making castings for enameling, the writer has found the above specifications quite satisfactory with the exception that the silicon content should vary from 1.50 to 2.50. In general the lower the silicon can be kept with good foundry practice the better the enameling qualities of the iron.

Mr. Manson has done a nice piece of experimental work and has shown the practical way to overcome a difficulty that has been experienced by many enamelers. For this he deserves the gratitude of the whole cast-iron enameling industry. The above quotations are given simply to emphasize the possibility, recognized by Mr. Manson, that the trouble may be due to separation of carbon in irons with low combined carbon.

ACTIVITIES OF THE SOCIETY

THE EIGHTEEN HUNDRED MARK PASSED

The "Young Lady Across the Way" was told the other day that a set back helped a football team a lot, whereas she had always thought the players in the other positions were just as important.

This month the set back on the AMERICAN CERAMIC SOCIETY football team was just a little more prominent than any other position. A number of small gains were made but only one man really distinguished himself. This was W. C. Lindemann who bucked the Enamel line for ten yards and successfully completed two forward passes to Danielson. Sortwell and Ayars made good gains around east and west ends respectively, while Ortman, M. E. Gates, Davis Brown, and MacMichael had the ticklish end of four forward passes.

Hursh, Frost, Wenning, and Knollman gained ten yards each by line plunges. Riddle made a quick recovery of a fumble and carried the ball ten more. Dornbach, Howe, and Lambie, the refractory back field, broke through their opponents for ten yards apiece. Lord, Lyon, Rand, Cox and Wilkins filled their positions creditably and carried the ball at various times for ten yards.

The record of each man follows:

	Personal	Corporation		Personal	Corporation
W. C. Lindemann	1	2	F. H. Riddle	1	
E. E. Ayars	2		H. J. Knollman	1	
H. H. Sortwell	2		W. E. Dornbach	1	
P. S. MacMichael		1	R. M. Howe	1	
Davis Brown		1	J. M. Lambie	1	
F. B. Ortman		1	F. G. Lord	1	
M. E. Gates		1	J. B. Lyon	1	
R. K. Hursh	1		C. C. Rand	1	
L. J. Frost	1		P. E. Cox	1	
W. F. Wenning	1		W. W. Wilkins	1	
			Office	7	1

Total 25 Personal, 7 Corporation

The net increase for ten months of 1922 is:

	Personal	Corporation
Nov. 15, 1922	1593	218
Jan. 1, 1922	1350	139
Net increase	243	79

The gross increase by periods since June, 1921 is as follows:

	Personal	Corporation	Total
June to September, 1921	41	11	52
September to December	18	2	20
December to February	136	21	157
February to May	81	10	91
May	13	13	26
June	13	5	18
July	25	11	36
August	20	5	25

	Personal	Corporation	Total
September	31	11	42
October	31	12	43
November	25	7	32
Gross increase	434	108	542
Loss	82	5	87
Net increase	352	103	455

Not so many years ago an enthusiastic member of the SOCIETY was heard to say that he believed the SOCIETY could reach in time the dizzy height of 750 members. This remark was tolerated by the more conservative as youthful exuberance, gently but firmly to be suppressed.

On November 1, 1922, the mail brought into the office of the Secretary contained two personal and three corporation application cards, and the total membership was magically raised to more than 1800. Now probably some bold, young spirit will rashly declare that we shall have 3000 members in a few years. The very idea!

NEW MEMBERS RECEIVED FROM OCTOBER 16 TO NOVEMBER 15

ASSOCIATE

Alderson, Benjamin, Chemist, American Bottle Co., Streator, Ill.

Boeker, Victor W., 1111 W. Stoughton St., Urbana, Ill., Student.

Bowne, Martin S., 422 W. Locust St., Clearfield, Pa., Supt., Clearfield Sewer Pipe Co.

Bryson, Frank W., Charleston, W. Va., Supt., West Virginia Brick Co.

Davies, James A., 1727 Bryn Mawr Rd., Cleveland, Ohio, Enameling Foreman, Vitreous Enameling Co.

Dougherty, George C., P. O. Box 667, Reading, Pa., Supt., Reading Vitreous Enameling Works.

Gaardsmoe, H. L., 141 Industrial Bldg., Bureau of Standards, Washington, D. C., Research Fellow.

Keeler, R. B., 2298 E. 52nd St., Los Angeles, Cal., Pres., Southern California Clay Products Co.

Kennelley, Griffith S., 302 Union St., Joliet, Ill., Sales Representative, American Refractories Co.

Leonard, Philip C., 210 Iowa Ave., Joliet, Ill., Sales Representative, American Refractories Co.

Minnigerode, J. H., P. O. Box 935, Baltimore, Md., Foreman, American Refractories Co.

Morris, Bernard L., 50 S. 11th Ave., Coatesville, Pa., Midvale Steel and Ordnance Co.

Owen, W. G., Haws Refractories Co., Johnstown, Pa., Asst. Sales Manager.

Paxton, Elisha W., 118 Le Moyne Ave., Washington, Pa., Highland Glass Co.

Peck, J. Clair, 4961 Neosho St., St. Louis, Mo., Burn Despatcher, Laclede-Christy Clay Products Co.

Peters, M. F., 534 11th St. S. E., Washington, D. C., Associate Ceramic Engineer, Bureau of Standards.

Radcliffe, Louis C., Jr., 10500 Clifton Blvd., Cleveland, O., Salesman, Roessler & Hasslacher Chemical Co.

Rockwood, Nathan C., 542 S. Dearborn St., Chicago, Ill., Editor and Vice Pres., "Rock Products."

Scherer, Oscar, 940 McAllister Ave., Columbus, O.

Shedd, Solon, College Station, Pullman, Wash., Prof. of Geology and Head of the Dept. of Geology.

Straight, F. W., Auburn Brick & Tile Co., Gen. Mgr., Auburn, Sac Co., Iowa.

Thrower, Wm. John, Minerva, Ohio, Supt., Owen China Co.

Weidman, Frank A., 38 S. Dearborn St., Chicago, Ill., Special Representative, Inland Steel Co.

Welsford, Henry R., 2022 N. Broad St., Philadelphia, Pa., Research Laboratory, Abrasive Co., Bridesburg, Pa.

Wirick, Jean Paul, 2611 W. 62nd St., Chicago, Ill., Pottery Instructor, Technical High School.

CORPORATION

Clay Service Corp., 138 N. La Salle St., Chicago, Ill.

Elgin Butler Brick & Tile Co., Austin, Texas.

Hadfield-Penfield Steel Co., Bucyrus, Ohio.

Mansfield Sheet & Tin Plate Co., Mansfield, Ohio.

Northern Clay Co., Auburn, Washington.

Portsmouth Stove & Range Co., Portsmouth, Ohio.

Tropico Potteries, Inc., Glendale, Calif.

WHO'S WHERE IN THE AMERICAN CERAMIC SOCIETY?

Earl B. Baker, one of the crew of the U. S. Bureau of Mines Laboratory Car, has recently accepted a position with the Southern Clay Company, of Robbins, Tenn.

Daniel D. Berolzheimer, Assistant Technical Editor of the Chemical Catalog Co., Inc., notifies us that the offices of the company have been moved from One Madison Ave. to 334 Fourth Ave., New York City.

A. W. Bitting, Director of Research of the Glass Container Association of America, has moved from Chicago to 1912 Clinton Ave., Alameda, Cal.

Mrs. J. T. Bramlett is now living at 1698 Glenview Ave., Memphis, Tenn.

O. O. Bowman, 2nd has severed his connection with the Trenton Fire Clay and Porcelain Company and is giving all his time to the Bowman Coal Co. of which he is Secretary and Treasurer. His address is the Broad Street Bank Bldg., Trenton, N. J.

Robert Brewster, formerly of Chicago, has taken up his residence at 119th and 86th Sts., Palos Park, Ill.

Albert D. Busch, of the W. S. Tyler Co., has changed his address from Pershing Ave. to 4945 Spalding Ave., St. Louis, Mo.

C. V. Cameron, formerly of Richmond, Cal., is now with the Whiting-Mead Commercial Co., 2035 E. Vernon Ave., Los Angeles, Cal.

Rod. Castro Oliveira, who has been studying at the New York State School of Ceramics, Alfred, N. Y., for the past three years, is on his way home to Santiago, Chile, and is at present in England.

Dorothy Peck Chapman has moved from Greenfield, Mass., to 131 N. 19th St., East Orange, N. J.

A. L. Duval d'Adrian, formerly of Washington, Pa., is now located at Alton, Ill.

Leon E. Ells, who graduated from the New York State School of Ceramics last June, is with the Laclede-Christy Clay Products Co., St. Louis, Mo. His address is 4425 A Flad Ave.

T. W. Garve, of the Ceramic Supply & Construction Co., has changed his residence to 55 N. 20th St., Columbus, Ohio.

Wm. H. Grueby has recently changed his address from Perth Amboy, N. J., to 680 Madison Ave., New York City, where the Exhibition Rooms of the Grueby Faience & Tile Co. are situated.

Herman A. Hall, who is with the Medina Clay Products Co., Medina, Ohio, recently called at the office of the Secretary and denied the rumor that he had been "lost."

Fred T. Heath, of the Heath Unit Tile Co., has been transferred from Seattle, to Tacoma, Wash., where his address is the Puget Sound Bank Bldg.

Joseph W. Hoehl has moved from Piqua, Ohio, to Detroit, Mich., where he is with the Wolverine Porcelain Enamel Co.

W. W. Ittner, Treasurer of the General Clay Products Corp., St. Louis, Mo., gives as his new home address 5141 Waterman Ave.

Walter A. King, of the Elyria Enameled Products Co., is now living at 149 Branston Ave., Elyria, Ohio.

Charles Laird, formerly of St. Louis, is now affiliated with the Southern Clay Mfg. Co., North Birmingham, Ala.

J. S. Laird has moved from Charleston, W. Va., to Imlay City, Mich.

A. Malinovszky is with the Washington Iron Works, Los Angeles, Cal.

C. R. Minton, who graduated from the Ceramic Department of Ohio State University last June, has accepted a position with the Los Angeles Pressed Brick Co., Los Angeles, Cal.

J. A. Nagle, of the Pittsburgh American China Co., has gone from Columbus, Ohio, to live at 315 Center Ave., Greensburgh, Pa.

Fred H. Schwetye, of the Laclede-Christy Clay Products Co., has changed his address from Manchester Ave., to 5445 Queens Ave., St. Louis, Mo.

B. T. Sweely, formerly with the Coonley Mfg. Co., Cicero, Ill., has recently accepted a position with the Cribben & Sexton Co., Chicago, Ill.

A. J. Walcott, who last month appeared among the "lost," has notified the office that he is doing graduate work in the Department of Geology at Northwestern University, Evanston, Ill.

R. H. White, of the Norton Co., is now living at 617 Buffalo Ave., Niagara Falls, N. Y.

C. L. Wigfield, of the Elyria Enameled Products Co., has moved from W. Broad St. to 438 Cleveland St., Elyria, Ohio.

NO ADDRESSES

The list of unknown addresses remains about the same. Some are located each month, but a few others are A.W.O.L. Information will be gratefully received by the Secretary.

Baker, G. V., Penn Feldspar Co., Philadelphia, Pa.
Bickel, Earl A., Postville Clay Products Co., Postville, Iowa.
Brett, R. C., Southern Clay Mfg. Co., North Birmingham, Ala.
Callaghan, J. P., c/o Teaque Hotel, Montgomery, Ala.
Dolley, Charles S., Keramoid Mfg. Co., Fort Madison, Iowa.
Greenwood, John L., Lehigh Sewer Pipe and Tile Co., Lehigh, Iowa.
Groocock, Alice, 865 Bathurst St., Toronto, Ont.
Kitamura, Y., Shofu Kogo Kafushiki Kaisha, Kyoto, Japan.
Knote, J. M., Mines Dept., Sault Ste. Marie, Ont.
Lodwick, J. A., American Arch Co., 17 East 42nd St., New York City.

Mitchell, Leon W., Rock Island Stove Co., Rock Island, Ill.

Morrow, Robert P., Harbison-Walker Refractories Co., 1513 Rockefeller Bldg., Cleveland, Ohio.

Okura, K., 84 Kobayashi-Cho, Nagoya, Japan.

Pendrup, W., Coonley Mfg. Co., Cicero, Ill.

Pulsifer, H. M., Geo. H. Holb & Co., Chicago, Ill.

Ragland, N. A., Alberhill Clay and Coal Co., Los Angeles, Cal.

Reid, W. H., 10 Stanley Place, Yonkers, N. Y.

Stewart, John G., 530 Union Trust Bldg., Cincinnati, Ohio.

Van Moore, A. L., American Photo Glass & Export Co., New Eagle, Pa.

Vodick, William J., 1733 Lake Ave., Wilmette, Ill.

Yamamoto, Tamesburo, Yamatame Glass Mfg. Co., Osaka, Japan.

AN EXTRA INDUCEMENT

It has been voted by the Board of Trustees to allow new members now to join the SOCIETY for 1923 and to purchase the *Journal* for 1922 at member's rate, if they desire.

Persons who wish to take advantage of this offer will therefore pay

Dues for 1923	$7.50
Journal for 1922 at member's rate	4.80
	$12.30

and obtain the principal privileges of membership for two years at a saving of $2.70.

Members are urged to use this argument in connection with their invitations to others to join the SOCIETY.

ASK THAT MAN TO JOIN

There are many who would join the SOCIETY when the opportunity is presented. Here is a letter typical of several we have received:

> "Mr. S. F. Walton of the Northern Refractories Co. has advised me that I can join your Society. I am greatly interested in the Refractories Division and, if agreeable, will you kindly send application blank and bill for dues."

ADVANCE NOTICE SECOND ANNUAL CERAMIC EXHIBITION

Twenty-Fifth Annual Convention American Ceramic Society

JAMES C. BOUDREAU, DIRECTOR OF ART EDUCATION, 725 FULTON BLDG., PITTSBURGH, IS CHAIRMAN OF THE COMMITTEE ON EXHIBITION

In planning for the second Ceramic Exhibition to be held during the coming Convention in February, it is obvious that this should be in harmony with the occasion of the celebration of the Twenty-Fifth Anniversary of the founding of the AMERICAN CERAMIC SOCIETY.

Not only should the present ceramic field be adequately represented, but where possible, examples showing the development during the past twenty-five years should be included.

No one will question the accomplishments in American ceramics during this comparatively short space of time. No other country can show such technical and practical development within such a short period. But unfortunately, there have been few opportunities to show collectively the various types of ceramic work together with examples showing developments covering a period of years.

The Exhibition last year was the first attempt to do this, and the result was successful enough to make the Exhibit an annual event.

Members of the SOCIETY are urged to coöperate in making this Exhibition a distinctive event.

Members having examples of early American pottery and glass are asked to loan these during the period of the Exhibit.

Every care will be taken of the exhibits, and expert packers will be engaged to pack for return shipment.

The various exhibits will be classified as follows:

- A. Utilitarian White Ware
- B. Electrical Porcelain
- C. Chemical Porcelain
- D. Sanitary Ware
- E. Terra Cotta
- F. Building Brick and Tile
- G. Floor and Wall Tile
- H. Faience
- I. Art Pottery
- J. Chemical Stoneware
- K. Utilitarian Stoneware
- L. Sewer Pipe
- M. Enameled Ware
- N. Glass
- O. Refractories
- P. High School Pottery
- Q. Universities and Bureaus

The Universities and Bureaus are urged to exhibit examples and methods of research.

Exhibition blanks and shipping tags will be sent out at a later date.

The Exhibition Committee Personnel:

Chairman: James C. Boudreau
White Ware: Lawrence Brown
Heavy Clay Products: C. Forrest Tefft
Glass: J. C. Hostetter
Refractories: R. F. Ferguson
Enamel: B. T. Sweely
Art: F. H. Rhead
Terra Cotta: R. L. Clare

CHICAGO LOCAL SECTION

A letter to the members of the Chicago Section of the AMERICAN CERAMIC SOCIETY has been issued by the Chairman, F. L. Steinhoff, calling the sixth annual meeting for Saturday, December 2. The program committee is putting forth special efforts to secure excellent papers and speakers for the occasion, and a large attendance is anticipated.

INQUIRIES FOR TECHNICAL INFORMATION RECEIVED FROM READERS DURING OCTOBER

The following questions pertaining to ceramic problems have been received by the Secretary of the SOCIETY recently. These problems presented are typical of the many which come in every month. Members who are interested in discussing these questions may send their discussions to the Editor's office (Lord Hall, O. S. U., Columbus, O.) where they will be edited and published.

(1) A chemical engineer wishes advice regarding refractories to withstand about 3600°F generated by an oil burner. Fire brick readily melts.

(2) Please advise where I can get a formula for engobe coating for use under glaze on solid porcelain material.

(3) I am in the stoneware and flower pot business and am especially interested in glazes for stoneware bodies. If the CERAMIC SOCIETY has anything on this subject would be pleased to receive same.

(4) Would you please advise as to the materials used, and their proportions, for white vitreous floor tile.

(5) We have used several different formulas for brown glazes for insulators each showing a variation in color in burning. Could you suggest a formula of a glaze that would be more stable in color?

(6) Would you be good enough to give us a list of glass sand manufacturers?

(7) We have, from time to time, been purchasing fused silica scrap in quantities of a few hundred pounds. Our requirements have increased so that in the future our purchases will be lots of several tons. Can you tell us how it is produced and whether it is a commercial product? Can you tell us which manufacturers or class of manufacturers would be most likely to be in position to supply us?

(8) Do you know of a book entitled "Laws and Rules of Clay Mining?"

(9) Can you give us a comparison of the melting points of German and Orton cones?

(10) I am anxious to get what data I can on the cost of handling different clay materials in the factory. I am naturally more interested in tiles than anything else, but articles on the costs and the best way of handling, not only tiles, but terra cotta or porcelain of any kind, would help me. I do not know if you have any articles of this kind, but if you have, I wish you would kindly send them to me with a bill for the same.

PUBLICATIONS OF THE AMERICAN CERAMIC SOCIETY

Single Volumes of the *Transactions* and *Journal* and separate numbers of the *Journal* may be obtained through the office of the Secretary. Members are allowed 40% discount from list for all Volumes of the *Transactions* and for all other than the current numbers of the *Journal*. The list prices are as follows:

	Transactions		
Vol. I	1899	110 pages	$4.75
Vol. II	1900	278 pages	in complete set only
Vol. III	1901	238 pages	$4.75
Vol. IV	1902	300 pages	$5.50
Vol. V	1903	420 pages	out of print
Vol. VI	1904	278 pages	$6.50
Vol. VII	1905	454 pages	$6.50
Vol. VIII	1906	411 pages	$6.50
Vol. IX	1907	808 pages	out of print

	Transactions			
Vol. X	1908	582 pages	in complete set only	
Vol. XI	1909	632 pages	$6.50	
Vol. XII	1910	882 pages	out of print	
Vol. XIII	1911	837 pages	$6.50	
Vol. XIV	1912	888 pages	in complete set only	
Vol. XV	1913	747 pages	$8.00	
Vol. XVI	1914	611 pages	$8.00	
Vol. XVII	1915	815 pages	$8.00	
Vol. XVIII	1916	947 pages	$8.00	
Vol. XIX	1917	707 pages	out of print	
	Journal			Single Nos.
Vol. I	1918	892 pages	$6.00	60c.
Vol. II	1919	1030 pages	$6.00	60c.
Vol. III	1920	1016 pages	$6.00	60c.
Vol. IV	1921	1050 pages	$8.00	75c.
Vol. V	1922	1671 pages	$8.00	75c.

A complete set of the *Transactions*, minus Vols. V, IX, XII, and XIX which are out of print, may be purchased at..$150.00.

(Second-hand copies of Vols. V, IX, XII and XIX are sometimes available. Orders for these should be filed with the Secretary.)

To members of the SOCIETY a reduction of 40% will be made from the above prices. Members cannot purchase more than one copy of each volume at members' rate.

The SOCIETY has also published the following books, which will be sold net, at the prices listed, to the public and members alike:

"The Collected Writings of Dr. Hermann August Seger," Vol. I, (*a*) Treatises of a General Scientific Nature. (*b*) Essays and Refractory Wares. 552 pages. Bound in cloth.. $7.50

"The Collected Writings of Dr. Hermann August Seger," Vol. II, (*a*) Essays on White Ware and Porcelain. (*b*) Travels, Letters and Polemics. (*c*) Uncompleted works and extracts from the archives of the Royal Factory. 605 pages. Bound in cloth.. $7.50

"A Bibliography of Clays and the Ceramic Arts," by Dr. John C. Branner, 1906. 451 pages. Bound in cloth. Contains 6027 titles of works on Ceramic subjects.. $2.00

"Collective Index to the *Transactions of the American Ceramic Society*," compiled by E. J. Crane.. $1.50

ELECTRIC FURNACE FOR GLASS MANUFACTURING

An Inquiry from Dr. M. E. Holmes, Acting Secretary and General Manager of National Lime Association

During the past months I have been in correspondence with a number of people on the subject of furnaces for glass making. As is well known the ordinary glass tank furnace is notoriously inefficient; only about 10% of the heat is utilized. The question has arisen regarding the utility of an electric furnace which of course might be insulated in such a way as to make the heating efficiency very much higher. In these days of fuel shortage it seems especially important to call the attention of the AMERICAN CERAMIC SOCIETY to this fundamental problem.

If there is any way in which interest in this matter could be stimulated so as to initiate research work on a commercial scale, it seems as if it would be well worth while. I would appreciate very much if you could see your way clear to lay this matter before one of your Committees or refer the matter to Dr. Tillotson, or give it your personal attention. I am informed by one of the electric companies that they believe there are important possibilities in the development of an electric furnace for glass manufacture. If such a project should be successful it would tend of course to concentrate the glass industry at Niagara Falls, but I can see no serious objection to that.

A MESSAGE FROM THE CHAIRMAN OF THE RESEARCH COMMITTEE

By Wm. M. Clark

Referring to your letter regarding featuring research work and encouragement of research by the Society in the December issue, I have been trying to think of some constructive suggestions.

One activity it might be well for the Society to consider is the establishment of some prizes or medals to be annually awarded for research work to students in colleges, technical schools and even high schools, resulting in essays or theses to be published in the *Journal*. Some of the technical societies have considerable funds for this purpose. Perhaps the American Ceramic Society has only limited funds, but even an appropriation of $100 or $200 to be divided up into a series of prizes might serve as a starter and some gifts might result later. For example this society might have an Orton medal similar to the Nichols and Grasselli medals, etc. Would suggest grading the prizes and making the minor grades a paid up membership in the Society.

Then again we should give a broad definition to the term "Research" and not make it appear too much of a pure science nature, for instance some such definition as "Keeping One's Eyes Open." Following out this thought we should ask manufacturers and ceramists in general to be observing, noting peculiar results, crystals, fusions, corrosion effects, freakish products, unusual troubles, remarkable results and to save samples and note conditions that produced such effects. Next if the interest of the schools where thesis work is carried on can be excited and they can be told that such and such problems exist and that samples may be obtained from Mr. Blank, we may make some progress in bringing the man who has a problem and the man who can help solve it together.

Each problem should first be brought to the attention of the chairman of the Research Committee of the Division, representing the industry to which the problem or observation belongs.

COMPARISON OF JOURNALS

	1921	1922
Original Papers in Journal Section	74	103
Original Papers with Discussions	5	20
Number of Abstracts	765	1530
Original Papers in Bulletin	No Bulletin	15
Discussions in Bulletin	No Bulletin	44
Pages	1050	
Original Section		944
Abstracts		340
Bulletin		387
Total pages	1050	1671

An increase in size of type page from:

$4'' \times 6\ ^1/_4''$ to $4^1/_2'' \times 7^1/_4''$

makes an increase of about 26% more space filled on each page. This larger type page first appeared in May, 1922.

NOTES AND NEWS

REPORTS FROM THE CERAMIC ENGINEERING DEPARTMENTS OF OUR UNIVERSITIES

The Ohio State University

The enrollment for the current year is as follows:

Sophomores	22
Juniors	10
Seniors	12
Graduate Students	4

The freshmen have not indicated their choice of courses so that the enrollment can only be estimated.

The equipment of the Department has been increased during the past year by the addition of a gas and oil fired muffle kiln with inside dimensions $2'\ 0'' \times 2'\ 0'' \times 2'\ 6''$ (for the study of terra cotta). Recording and indicating pyrometers from The Brown Instrument Co. and The Bristol Co., have also been received, which add greatly to the laboratory equipment. The Maxon Furnace & Engineering Co. have furnished a No. 1 Maxon Burner, thus improving the furnace equipment.

The change in the teaching schedules from two semesters to three quarters will increase the efficiency by permitting more concentration in the different courses, fewer subjects being studied at any given time.

The graduates of the Class of 1922 are located as follows:

E. R. Curry, Gladding McBean & Co., Lincoln, Calif.
A. L. Donnenwirth, Jeffery-Dewitt Insulator Co., Kenova, W. Va.
H. E. Ebright, The Ferro-Enameling Co., Cleveland, O.
R. E. Hanna, Atlantic Terra Cotta Co., Perth Amboy, N. J.
R. S. Kane, Jeffrey Mfg. Co., Columbus, O.
P. W. Lee, Heinz Roofing Tile Co., Denver, Colo.
C. R. Minton, Los Angeles Pressed Brick Co., Los Angeles, Calif.
D. M. McCann, The Sterling Grinding Wheel Co., Tiffin, O.
Burnette Purcell, National Fire Proofing Co., Aultman, O.
Willard Stief, Mount Clemens Pottery Co., Mount Clemens, Mich.
B. E. Whitesell, Kier Fire Brick Co., Salina, Pa.

The Student Branch of the American Ceramic Society was regularly organized for the 1922–1923 school year on October 24. The following officers were elected:

Chairman, C. A. Smith,
Vice Chairman, Edward Burkhalter,
Sec.-Treas., A. B. DeVol.

Meetings will be held on the first Tuesday night of each month and talks by prominent ceramic men will be given.

At each meeting a member of the senior class makes a short talk reporting on some practical ceramic experience gained through summer work.

New York State School of Ceramics

The registration figures at Alfred show the present student body distributed as follows:

	Men	Women	Total
Graduate Student	1	0	1
Seniors	10	2	12
Juniors	20	7	27
Sophomores	20	11	31
Freshmen	18	7	25
	69	27	96

This number is eight less than last year when an exceptionally large freshman class entered, still shown in the number of sophomores.

The staff of the engineering department has undergone no changes but in the Applied Art department Miss Erna Sonne, a graduate of the Rhode Island School of Design and recently Assistant Supervisor of Art in Syracuse, has taken the place of Miss Nelson, former Associate Professor of Design, who is now teaching in the Toledo Art Museum School.

On account of the large number of lower class men in the laboratories, adjustments have been made whereby the former furnace room has been converted into a Senior laboratory, and the furnaces have been assembled in the few vacant places left in the kiln house. On account of the lack of funds no important changes of equipment have been possible. The force of instructors is increasingly pressed for time and laboratory space for classes, and it is hoped that the efforts continually being put forth for increased appropriation may soon show results.

Graduates of last June are placed as follows:

Robert H. Armstrong, Fiske & Co., Watsontown, Pa.
Donald Bassett, National Fireproofing Co., N. Canton, Ohio
Robert Boyd, Sinclair Oil Co., Wellsville, N. Y.
Robert Clark, 560 Elmwood Ave., Providence, R. I.
Leon B. Coffin, Onondaga Pottery Co., Syracuse, N. Y.
Max D. Compton, Los Angeles Pressed Brick Co., Los Angeles, Cal.
Leon E. Ells, Laclede-Christy Clay Products Co., St. Louis, Mo.
J. Clair Peck, Laclede-Christy Clay Products Co., St. Louis, Mo.
Thomas C. Walker, Mosaic Tile Co., Matawan, N. J.
Alfred Whitford, Fiske & Co., Watsontown, Pa.

The Student Branch of the American Ceramic Society has begun its work and officers for the year have been elected as follows:

President, John McMahon
Sec.-Treas., Harold Rogers
Councilor, J. B. Shaw

University of Illinois

The new school year has opened with an attendance of 77 undergraduates, distributed as follows:

Seniors	18	Sophomores	22
Juniors	18	Freshmen	19

Graduate Students........ 3

Besides these students registered in the course, there are several students coming from other departments in some of the classes.

The Department staff has undergone quite a change during the past summer. Dr. E. W. Washburn, former head of the Department has resigned and is now in Washington as Editor of Critical Tables which are being published by the National Research Council.

G. R. Shelton, Corning Glass Works Fellow, who has been working in the Department for some time on glass research problems completed the requirements for his doctor's degree in June. He is now a member of the staff of the Department of Chemistry of the University of Saskatchewan.

E. E. Libman who has been connected with the Department as instructor since 1918 received his doctor's degree in June and has been transferred to the Mathematics Department, where he is now an instructor.

Roger Doyle, laboratory attendant, after being with this Department for a few ıonths has withdrawn to enter industrial work.

T. N. McVay, a graduate of this Department in 1914, and since employed in various ınts engaged in the manufacture of clay products, has joined the staff as instructor.

It is expected that another instructor will shortly join the staff.

The Department has been quite fortunate in being able to add several important items to its equipment. We have purchased and installed a No. 328 auger brick machine with a side cut-lubricating brick die, one 5″ x 8″ hollow block die, one 4″ drain tile and one 8″ drain tile die, together with other items which especially adapt this machine for class instruction. This machine was purchased from the Hadfield-Penfield Steel Company of Bucyrus, Ohio.

Also, we have increased our pottery equipment by three standard jiggers and three standard pulldowns purchased from the Crossley Machine Company, one revelation pottery kiln made by the H. J. Caulkins Company, and a wall indicator with twelve point switch box furnished by the Charles Engelhard Company for use with the various furnaces and kilns.

The course in Ceramic Chemistry which was formerly known as the course in Ceramics is now in operation. This course is designed for the special training of ceramic chemists and differs from the course in ceramic engineering by the substitution of a larger amount of chemistry for engineering topics. Some years ago before the Department was transferred to the Engineering College a similar course was provided which, according to our recollection, was done at the instance of Ross C. Purdy who was in charge of the work at that time. This course seems to be attracting gratifying attention on the part of students who are looking forward to doing work of a purely chemical nature.

Our senior students will leave in charge of Professor Hursh on the annual inspection trip October 26, going to St. Louis where they will visit the following plants:

Laclede-Christy Fire Brick Company; Evens and Howard Fire Brick Company; Hydraulic-Press Brick Company; Mississippi Glass Company; Alton (Illinois) Paving Brick Company; Illinois Glass Company, Alton, Illinois.

Graduates of last June are scattered widely.

R. E. Arnold—Westinghouse Electric and Mfg. Co., Pittsburgh, Pa.

D. B. Atwell—Evens and Howard Fire Brick Company, St. Louis, Mo.

I. B. Branham—Batchelder Wilson Tile Co., San Diego, California.

H. T. Coss—on the staff of the Department of Ceramics at Rutgers College, New Brunswick, N. J.

J. R. Green—North Iowa Brick and Tile Company, Mason City, Iowa.

J. Lathrop—Tropico Potteries Company, Glendale, California.

R. E. Lowrance—Matawan Tile Company, Matawan, N. J.

STUDENT SOCIETIES

The Student Section of the AMERICAN CERAMIC SOCIETY held its first meeting on Thursday, October 12. The officers for the current year are:

O. S. Mundy, Chairman
S. Q. Lee, Secretary-Treasurer.

The officers of the *Keramos* fraternity are:

H. G. Wolfram, President
S. O. Neiswanger, Vice-President
P. F. Larson, Secretary
H. T. Leverenz, Sergeant-at-Arms.

Iowa State College

The Ceramic Department of Iowa State College has 11 students in course distributed as follows: two Freshmen, four Sophomores, four Juniors, and one Senior.

To the faculty has been added this year Miss Ethel J. Bouffleur, University of Washington, who will teach pottery decoration and handmade pottery.

A steel-jacketed kiln with removable crown and with three fire boxes, all designed to make possible the use of any sort of fuel, to make heat balance computations easily, and to carry on any ordinary ceramic firing process under approximately commercial conditions, has been built by student labor from designs by Professor Cox. Parts are at hand for the building of a test furnace for refractories after the drawings and descriptions in the October, 1922, issue of the *Journal* as presented by Professor Moulton. Since nothing but a portable kiln has been in the Department for some years these two kilns help greatly.

In ceramic engineering no new courses or changes have been made. It has been decided to manufacture pottery in a limited way to demonstrate the use of Iowa clays and shales in finer wares than are now made and to satisfy requests that make this plan advisable.

Wayne E. Barrett, who graduated last year, is located with the Adel Clay Products Co., Adel, Iowa. Leslie R. Alt, who would have finished this year, has elected to spend a year in putting into running condition a plant that belongs to the firm of which his father is general superintendent. He will return for his degree later.

The Student Branch of the AMERICAN CERAMIC SOCIETY at Ames is the required Seminar. It meets weekly at the day and hour set into the college calendar. The program is made up by a student member, the same man serving throughout the year. Faculty men from all over the campus are invited to talk on matters of interest to the ceramist, from choice of electives to how the physical chemist will help the ceramist, and each member talks once during the year on some subject that pleases him. Frequent use is made of the excellent visual instruction service available at Ames. Bruce F. Wagner, President, Robert C. Boyd, Secretary, and Benjamin W. Willson, Treasurer.

Frequent meetings are held in addition to the regular meetings as the Department is active in all college affairs and finds time to match showings with the more robust departments of Iowa State College.

Rutgers College

The number of ceramic students at Rutgers College and the State University of New Jersey is steadily increasing and on Registration Day, September 19th, the total enrollment was 28, classified as follows:

2 Seniors	8 Sophomores
8 Juniors	10 Freshmen.

Two new instructors, namely C. C. Clarke, B.Sc. (Colgate), M.Sc. (Rutgers) and H. T. Coss, B.Sc. (Illinois), have been added to the teaching staff.

Practically all of the machinery and equipment has been installed at the new building and laboratory work is progressing at a rapid stride.

The student organization, the Rutgers Ceramic Club, held its first meeting on October 19th in the lecture room of the new building. Following the business meeting and election of officers, a very interesting and instructive talk on Enameled Brick was given by Mr. Chas. E. Jacquart of the American Enameled Brick and Tile Co., South River, N. J. Mr. R. H. Minton and Professor G. H. Brown are the Councilors of the Club.

A TEN WEEKS' COURSE

Professor Hewitt Wilson who will have charge of the ceramic courses given at the College of Mines, University of Washington, sends the following notice which is being distributed for the purpose of advertising this course. Readers of the *Journal* will be interested in reading the variety of subjects given especially in the ceramic department.

27th Annual Winter Mining Session

College of Mines, University of Washington, Seattle
January 4–March 21, 1923

Quartz Mining

Ore Mining Methods	Ore Milling	Geology and Mineralogy
Drilling and Blasting	Mining Law	Principles of Chemistry
Forge and Foundry Practice	Mine Surveying	Fire Assaying (Gold-Silver)

Placer Mining

Dredging for Gold	Hydraulics	Electric Blast Firing
Testing Placer Ground	Boring Methods	Melting and Refining Gold

Coal Mining

Mine Rescue, First-Aid	Analysis of Coals	Coal Washing Methods

Ceramics

Clay Testing	*Stoneware*	*Glaze Studies*
Lime, Plaster, Cement	Whiteware	Clay Technology
Common and Face Brick	Refractories	Terra Cotta Manufacture

Expenses Consist of Laboratory Deposits for Material Actually Used and University Fee of $20.00. Thorough Equipment Is Available for All the Above Courses. No Previous Training is Required for Entrance. Anyone Who Can Read and Write English May Enroll.

A Postal Card to the College of Mines, Seattle, Will Bring Full Details Regarding this Session and the Regular University Courses.

GLASS EXPERTS WANTED BY TARIFF COMMISSION

Under the extended duties of the Tariff Commission in the Tariff Act of 1922 an increase of its technical staff is now under consideration.

Three or four men may be selected for schedule, two of which embrace the ceramic industries, and candidates qualified in glass will receive the first consideration.

The duties of appointees consist in collecting and assembling costs of production, prices of wares, marketing conditions, foreign and domestic, in brief, all the factors

that enter into the question of competition between materials and wares of domestic and foreign production.

Technical training is essential in order to enable the appointee to understand and analyze manufacturing principles, conditions and difficulties. But a knowledge of wares from the point of view of the buying public, that is to say, for utility and attractiveness, is no less needed.

United States Tariff Commission
John F. Bethune
8th and E Street, N. W.
Washington, D. C.

RESEARCH—A CONSTRUCTIVE TRADE ASSOCIATION ACTIVITY[1]

A Message from the U. S. Chamber of Commerce

The value of scientific research, both from an economic and an industrial standpoint, has never been so fully appreciated as at the present time. The problems of the recent war forced science and its research activities to the front in all the civilized countries of the world. It is now realized by leading manufacturers that scientific investigation is a necessary adjunct to efficient operation. A utilization of the scientific knowledge now available, and a sympathetic coöperation in the free interchange of such information will lead to the adoption of improved manufacturing processes and do much to obviate the dangers of ignorant, destructive competition. The realization of this fact is shown by the 500 or more firms now maintaining laboratories for industrial research.

If there were no correlation of effort on research work, much duplication might result. The logical solution, therefore, is to have the trade association make this correlation. This enables a pooling of resources to maintain a central laboratory to render service to a larger group than is possible with only individual laboratories. Another and very important factor, especially valuable in strengthening trade associations, is that such centralized research work makes it possible for the small manufacturer, financially unable to support an individual laboratory, to profit from the investigations carried on.

Trade Associations Conducting Research

It is not surprising, therefore, that a continually increasing number of trade associations are realizing the value of research as one of their most constructive activities. Of the 65 to 70 associations now engaged in this work to whom recent inquiry was sent by the Fabricated Production Department, 33 gave specific replies, indicating that 8 were conducting their research independently and 25 were acting in coöperation with some other agency. The general leaning is toward the scientific aspect of research work, as 19 are engaged exclusively in that class, 3 on general problems and 11 give attention to both types of problems.

In classifying the nature of association research work, the terms scientific and general have been used with the following meanings:

Scientific: When it relates to the chemical, physical, bacteriological or purely technical problems of an industry.

General: When it relates to the mechanical methods used in production, distribution, etc., and the study of non-technical and non-scientific problems of the trade.

An enumeration of the wide range of problems these associations are working on is not possible in a brief bulletin such as this.

[1] *Bulletin* issued by Fabricated Production Department, Chamber of Commerce of the U. S. A., E. W. McCullough, Mgr.

Coöperating Agencies

In the same manner that coöperation of manufacturers through their association prevents duplication, so does the coöperation of associations likewise prevent unnecessary waste of effort. There are a large number of technical and scientific agencies, both governmental and private, which welcome the active participation of trade associations in their research efforts. Only a few typical cases can be mentioned here, such as Forest Products Laboratory, Mellon Institute of Industrial Research, Bureau of Mines, Bureau of Standards, University of Illinois Engineering Experiment Station, Institute of Industrial Research and National Research Council. These are but a few of the 35 agencies which we know are already working on these problems, and there are, doubtless, a good many others, both public and private, which have been engaged in research for a number of years.

The Cost of Research

Probably few fields of association activity will produce greater ultimate returns than research. The Director of the Mellon Institute of Industrial Research is authority for the statement that "some one has estimated that one-half billion dollars is being saved annually through research for industry in the United States alone. It is not surprising to learn, therefore, that about $35,000,000 is being spent annually by American manufacturers in the conduct of laboratory research. No doubt, a like amount is expended in experimental and development work in the plants, that is, beyond the laboratory stage."

No specific statement of the cost of this work can be made as it varies according to the kind and amount of the work undertaken. Associations reporting to us give as their appropriation amounts varying from a few hundred dollars up to over $100,000 annually. Whatever the amount may be there is no doubt but that it is amply repaid in benefits secured.

Conclusion

The Fabricated Production Department is convinced that scientific research is an extremely important activity in which trade associations may engage legally and with great benefit to their members and the public generally. We stand ready to assist those associations desiring to undertake this work and the resources of the department are available to all those who wish to make use of them. We invite an expression of your opinion and an opportunity to serve you.

WHITEWARE STUDY IN PACIFIC NORTHWEST UNDERTAKEN BY THE U. S. BUREAU OF MINES

In the investigation of the white clays of the Pacific Northwest being made by the Seattle, Washington, experiment station of the Bureau of Mines, samples of kaolin were recently taken at Freeman and Mica, Washington, and at Joel and Troy, Idaho. The kaolins sampled will also be used in the refractory studies, in the hope that the quality of the fire brick from the companies operating in the district can be improved. The residual deposits of clay are more difficult to operate because of the lack of uniformity and the large quantity of decomposed schist and sand which are often in excess of the softened granitic material. Those deposits which have been at least partially water-sorted show more uniformity and greater concentrated quantities of white-burning clays. Several hundred pounds of feldspar were obtained from the old mica mines three miles north of Avon, Idaho. Heretofore, the feldspar has been thrown on the dump.

ENGINEERING FOUNDATION ELECTS A. D. FLINN TO NEWLY CREATED POST OF MANAGER

Election of Alfred D. Flinn as director of the Engineering Foundation, which is fostering organized industrial research on a nationwide scale, is announced by Charles F. Rand, chairman of the Foundation. Mr. Flinn is the first incumbent of the new post, created by the Foundation's governing board, composed of the Four Founder Societies.

ALFRED D. FLINN

Mr. Flinn will retire as Chairman of the Engineering Division of the National Research Council, a position which he has held since October, 1921, but will continue as secretary of the United Engineering Society in order that the Foundation may continue intimate relations with the Founder Societies. Mr. Flinn has been secretary of this society and of the Foundation since January, 1918, and is widely known by engineers throughout the country. He is a leading figure in engineering movements, including the plan to promote world unity, aid research and more thorough organization of the profession of engineering in this and other countries.

E. P. OGDEN WITH U. S. BUREAU OF MINES

Ellsworth P. Ogden, who was recently appointed Ceramic Engineer for the United States Bureau of Mines with headquarters at the Ceramic Experiment Station, Ohio State University, Columbus, Ohio, is an alumnus of Ohio State University of the Class of 1905. His engineering experience in the field of ceramics is good preparation for the service he has undertaken.

ELLSWORTH P. OGDEN

Mr. Ogden designed and built the Clay Craft Brick Company's plant at Shawnee, Ohio, in 1908, the original plant of the Murphysboro Paving Brick Company, Murphysboro, Illinois, in 1909, and the Harris Brick Company's plant, Zanesville, Ohio, in 1910. For three years he was factory engineer for one of the large terra cotta companies with duties at their five plants. Subsequently he has been engaged in the adaptation of producer gas to the firing of heavy clay wares, the manufacture of high voltage electrical porcelain, continuous tunnel kiln design and operation, floor and wall tile manufacture, vitreous enamel work. Mr. Ogden has been a member of the American Ceramic Society since 1906.

U. S. BUREAU OF MINES

Mineral Filler Investigation

In the course of the investigation of mineral fillers, being made by W. M. Weigel, mineral technologist, at the Southern experiment station of the Bureau of Mines, Birmingham-Tuscaloosa, Alabama, three special problems have been studied, *viz:* determination of grain size fillers, involving elutriation and microscopic measurement, followed by methods of calculation; the effect of heat treatment on the physical properties of white clays with respect to their use as fillers; and the utilization of Alabama flake graphite. The size of particle is a basic property of fillers upon which many of the other physical properties depend, consequently considerable work is being done in this direction. Work has been completed on the study of the effect of heat treatment on the physical properties of clays. The lubrication tests on graphite were satisfactory, while results of the moulding tests were negative. Experiments in the use of graphite as a remover of boiler scale were only partly satisfactory, being partly negative. A special investigation has been made of a series of clays from central Georgia and western Georgia with respect to their value as fillers.

U. S. BUREAU OF STANDARDS

Investigation of Vitreous China Bodies

The testing of specimens of vitreous china bodies made and fired in the factories has been completed. Specimens for the determination of porosity, transverse strength, compressive strength, and resistance to impact have been made from 11 commercial bodies fired at cones 6, 8, 10, 12, and 14. With the exception of the compression test, all of this work has been completed.

A meeting of the American Vitrified China Manufacturers Association was held at the Bureau on October 19 for the purpose of hearing a report on the work. All the results were explained and thoroughly discussed, and the data are now being compiled into a formal report.

Tests of Surface Condition of Molded Commercial Glass

A continuation of the work on glass containers with reference to their life in service has disclosed the fact that reheating the surfaces to the softening point retards penetration of moisture and reduces the tendency to disintegrate. This was shown to be the principal factor affecting the resistance of glass surfaces to disintegration rather than the degree of previous exposure of the surfaces to moisture. A study of the absorption of moisture at different temperatures of glasses of various composition is also being made.

Specifications for Biological Glass

The Bureau of Standards is collecting information from the Army, Navy, the Biological Survey, the Public Health Service, and manufacturers of biological products concerning the requirements of glass for this purpose and the desirability of preparing standard specifications covering the same. The Bureau has already assisted manufacturers of biological products in obtaining glass suitable for their use, but the requests have indicated a possible value for more complete specifications.

Bureau of Standards Conference with Vitrified China Manufacturers

A conference with the members of the American Vitrified China Manufacturers' Association was held at the Bureau of Standards on October 19 to discuss the results of the investigative work which the Bureau is doing in coöperation with these manufacturers. At this conference a report was presented by Mr. H. H. Sortwell, of the Bureau, giving the results of tests of china bodies burned in different parts of commercial kilns and also of tests of the same bodies burned to different temperatures in a laboratory kiln at the Bureau of Standards. This was an extensive piece of work as the bodies used by eleven different manufacturers were included and specimens burned to the different temperatures were tested for transverse strength, compressive strength, resistance to impact, and porosity.

In order to eliminate the personal factor in the preparation of the specimens, all of them were made by a representative of the Bureau of Standards, who went to each of the coöperating factories and prepared the test pieces to be burned at the factory.

The results were exceedingly instructive, showing the firing ranges of the different commercial bodies and the effect on strength and other properties of variations in the temperature attained in different parts of the commercial kilns. These results will aid materially in the preparation of specifications for hotel china and it is believed that this coöperative work will also assist the American manufacturers in maintaining the superiority of their product over that of foreign competitors.

A report of this investigation will be published in the near future.

SAGGER INVESTIGATION OF THE BUREAU OF STANDARDS

Within the last few weeks a large number of users of saggers have received from the Bureau of Standards a letter asking what sagger clays they are using. The purpose of this letter was to obtain information which, when properly coördinated, would constitute a survey of practically all the clays used in saggers throughout the United States. The same inquiry has been sent out to the members of the United States Potters Association, the Sanitary Potters Association, and the Tile Manufacturers Association, as well as to many of the manufacturers of electrical porcelain. There are unquestionably a considerable number of potters and tile manufacturers who are not included in the list and who, in consequence, have not received this letter. The Bureau would be glad to hear from all sagger users and invites those who have not received the letter to write voluntarily, giving the names of the clays that they are using, the localities from which they come and the names of producers or dealers from whom they are obtainable. The proportions in which the different clays are used in the sagger mix would be of interest, but it is not necessary that this should be stated.

A large number of responses to the letter of inquiry have been received and they show a very general appreciation of the importance of the investigation of problems relating to saggers as well as a wish, in practically every case, to contribute something to the work.

As a part of the sagger investigation, the Bureau is undertaking a study of the properties of practically all of the types of clays used in sagger making by American manufacturers. This in itself is an undertaking which will require considerable time, but the results of this part of the investigation will be made available as soon as this part of the work is completed. In order to obtain samples which would represent, as fairly as possible, commercial shipments and avoid the embarrassing questions that might otherwise arise as to the reliability of the results of the tests, the samples to be used in the investigation are being contributed by the users from their regular stocks. A large

number of samples, in two-hundred pound lots, are being shipped to the Bureau, freight prepaid, by purchasers, and the Bureau wishes to express its appreciation of this coöperation.

In order to forestall the inevitable question as to how far the Bureau will go in making public the results of tests of the various clays, it should be stated that the Bureau will follow its usual policy of withholding the names of brands and producers from publication. This appears to be necessary on account of the fact that the Bureau cannot control the future production of any grade of material and consequently the results of the tests made on any given clay, even assuming the sample to be representative of the clay at the time the tests were made, would be misleading if the brand were later to be improved or the reverse. The clays tested will be identified in the report by numbers, and the Bureau will be willing to give each user the numbers of the clays that he is using. Producers and dealers can obtain the numbers of their own clays with the understanding, of course, that this information shall not be published nor in any way used in advertising.

The study of sagger problems is no new thing and it is not to be expected that even the most important questions are going to be cleared up all at once, but it is the hope of the Bureau of Standards to contribute something within the next few months which will at least help to reduce the drain upon many manufacturers from the unsatisfactory service of saggers and possibly in some cases from expense occasioned by the use of clays requiring unnecessarily long hauls.

TWENTY-FIFTH ANNIVERSARY OF CERAMIC SCHOOL AT BUNZLAU, GERMANY

On November 4, 5, and 6, 1922, friends of the Ceramic School at Bunzlau gathered to celebrate the completion of twenty-five years of work by the school under the direction of Dr. W. Pukall. Dr. Felix Singer, a member of the AMERICAN CERAMIC SOCIETY, is on the Board of Directors of this school.

NATIONAL BRICK ASSOCIATIONS WILL MEET IN CLEVELAND IN 1923

The National Brick Manufacturers Association and the Common Brick Manufacturers Association will meet at Cleveland, Ohio, the week of Feb. 5, 1923. The fact that these organizations will gather at the same time and place augurs well for a record attendance, and Cleveland's central location is an added argument. The Hotel Winton will be headquarters for both conventions and all sessions and functions will occur there.

CALENDAR OF CONVENTIONS

American Association of Ice & Refrigeration—Washington, D. C., Probably March 1923.
American Association of Museums—Charleston, S. C., May, 1923.
AMERICAN CERAMIC SOCIETY—Pittsburgh, Pa., Feb. 12–16, 1923.
American Concrete Institute—Cincinnati, Ohio, Jan. 22–25, 1923.
American Engineering Standards Comm.—29 W. 39th St., New York City, Dec. 14, 1922.
American Face Brick Association—West Baden, Ind., Dec. 5–7, 1922.

American Foundrymen's Association—Date not determined.
American Institute of Mining and Metallurgical Engineers—New York City, Feb. 19–22, 1923.
American Malleable Castings Assn.—Cleveland, Ohio, Jan. 9–10, 1923.
American Metric Association—Boston, Mass., Dec. 30, 1922.
American Society of Mechanical Engineers—New York City, Dec. 4–8, 1922.
American Society of Refrigerating Engrs.—New York City, Dec. 4–6, 1922.
American Society for Testing Materials—Place not determined, June 1, 1923.
American Zinc Institute—St. Louis, Mo. or Atlantic City, N. J., First or second Monday in May, 1923.
Association of Scientific Apparatus Makers of the United States of America—Bureau of Standards, Washington, D. C., April 20, 1923.
Canadian National Clay Products Association and Western Ontario Clay Workers Association—Hamilton, Ont., January 24–26, 1923.
Chamber of Commerce of the U. S. A.—Place not determined, Week of May 7, 1923.
International Chamber of Commerce—Rome, Italy, Week of March 19, 1923.
Clay Products Association—Chicago, Ill., Third Tuesday each month.
Common Brick Mfrs. Association of America—Cleveland, Ohio, Week of Feb. 5, 1923.
Federated American Engineering Societies—Place not determined, Date not determined.
Manufacturing Chemists Association—New York City, June, 1923.
Mining and Metallurgical Society of America—New York City, December 7–13, 1922.
National Association of Mfrs. of Pressed and Blown Glassware—Pittsburgh, Pa., March 13, 1923.
National Association of Mfrs. of U. S.—New York City, Week of May 14, 1923.
National Association of Stove Mfrs.—Richmond, Va., May 9, 1923.
National Association of Window Glass Mfrs.—Place not determined, Date not determined.
National Association Builders Board of Control—Des Moines, Iowa, February, 1923.
National Bottle Mfrs. Association—Atlantic City, N. J., Last of April, 1923.
National Brick Mfrs. Association—Cleveland, Ohio, Week of Feb. 5, 1923.
National Canners Association—Atlantic City, N. J., Week of Jan. 22, 1923.
National Exposition of Power and Mechanical Engineering—New York City, December 7–13, 1922.
National Gas Association of America—Louisville, Ky., Spring, 1923.
National Jewelers Board of Trade—New York City, January 18, 1923.
National Paving Brick Mfrs. Assn.—Place not determined, Date not determined.
Sanitary Potters Association—Pittsburgh, Pa., Monthly Meetings.
Stoker Mfrs. Association—May or June, 1923, Place not determined.
Tile Manufacturers Credit Assn.—Beaver Falls, Pa., Quarterly Meetings.
U. S. Potters Association—Probably Washington, D. C., December 10, 1922.

NEW DEPARTMENT OF CERAMICS AND CLAY TESTING IS ORGANIZED

The University of Colorado has been given a small appropriation to start a Department of Ceramics and Clay Testing under the leadership of Professor R. D. George of the Geology Department. The other ceramic departments in the country will be interested in the welfare of the youngest addition to their family circle.

MEMBER OF THE AMERICAN CERAMIC SOCIETY WINS HONOR

W. H. Fulweiler, of Philadelphia, has been awarded the Grasselli Medal for his paper on "Chemical Problems in the Gas Industry," which he presented at the March 1922 meeting of the Society of Chemical Industry.

The Grasselli Medal is endowed by the Grasselli Chemical Company of Cleveland, Ohio, and is awarded by a Committee of the N. Y. Section of the Society of Chemical Industry for the paper presented during the previous year, that in the opinion of the Medal Committee offers the most useful suggestions in applied chemistry. The medal has been in existence for several years and has been awarded twice, the previous award being to Dr. Allen Rogers.

The medal was presented at a meeting of the Society of Chemical Industry held at the Chemists' Club, New York City, on October 20. Dr. H. S. Miner, Chief Chemist of the Welsbach Company and Vice-Chairman of the New York Section, made the presentation.

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To be selected by Divisions

Ceramic Education

To be appointed

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M. C. Booze
E. C. Hill
(c) Standardization of Tests:
All selected by Divisions
(d) Standardization of Products:
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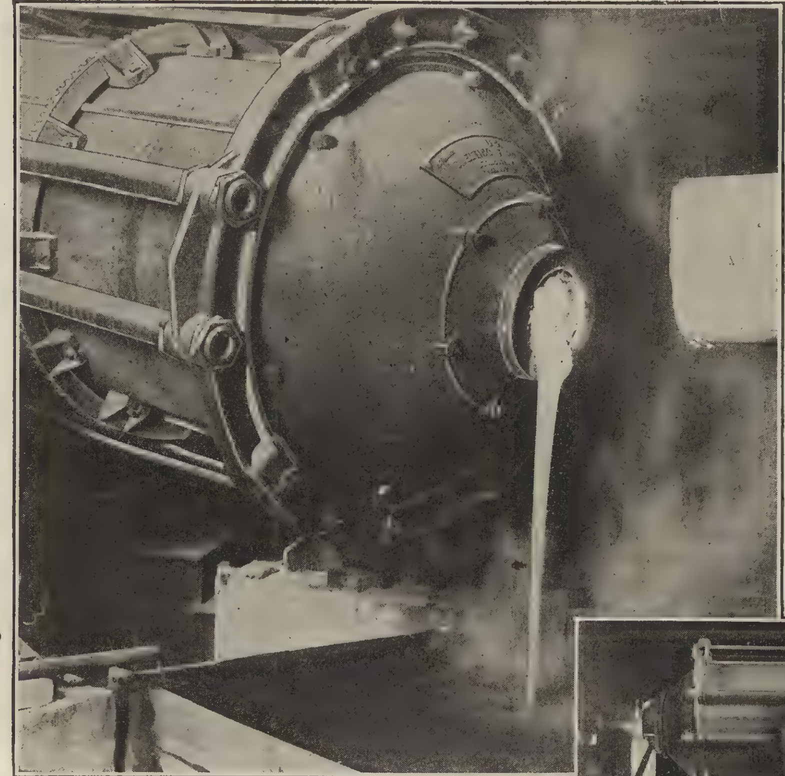

These illustrations made from photographs taken in the plant of Ingram-Richardson Mfg. Co., Beaver Falls, Pa.

"Our U. S. Enamel Furnaces Increase Output 25% per day at a Saving of 50% in Fuel Cost."

Ingram-Richardson Mfg. Company claim those remarkable results for their U. S. Enamel Furnaces. With four U. S. Furnaces operating at their plants at Frankfort, Indiana, and Beaver Falls, Pa., they are saving thousands of dollars yearly in fuel and labor.

Their white and colored enamels are smelted in quick time, with low loss. The work is easy and sure. The Furnace is under perfect scientific control. The melting process is visible. The Furnace rotates while melting and tilts when pouring. Linings last longer and cost less.

The U. S. Enamel Furnace is saving money over the old brick smelter in the Ingram-Richardson Mfg. Company plant. It will do the same for you.

Let the U. S. Furnace melt your enamel.

Write for specifications and prices on 60 lb., 150 lb., 400 lb., 750 lb., and 1200 lb. Enamel Furnaces. We will send photographs and list of users where furnaces are in operation.

THE
U. S. SMELTING FURNACE CO.

Better Drying for Dipped Ware

"Proctor" Automatic Mangle—type for one dipper. One of four at Shenango Pottery Co., New Castle, Pa.

"Proctor" Automatic Mangle—type for two dippers. One of two at Sebring Pottery Co., Sebring, Ohio.

The "Proctor" Automatic Mangle

Makers of General Ware who use "Proctor" Automatic Mangles will tell you these machines have improved their dipping results wonderfully.

The ware is dried uniformly and perfectly. It always has that firm surface which best resists scarring. There's no finger-marking or rubbing.

The Sebring Pottery Co., one of the enthusiastic users, recently wrote us: "We believe we will save each year in improved quality, many times the original cost."

This mangle makes dipping and drying a rapid, continuous process. Moving shelves receive the ware directly from the dipper and deliver it at the opposite end, within a surprisingly few minutes, dried perfectly.

An enormous output is obtained at great savings of time, space and labor.

PROCTOR & SCHWARTZ, Inc.

PHILADELPHIA, PA.

"Proctor" DRYERS

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- Chambers Brothers Co.
- Crossley Machine Co.
- Manufacturers Equipment Co.

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- Philadelphia Drying Mch. Co.

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- Crossley Machine Co.
- Hardinge Co.
- Mueller Machine Co., Inc.

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- Seaboard Fuel Corp.

Boilers
- Nashville Industrial Corp.

Brick Making Machinery
- Chambers Brothers Co.

Business Education
- Alexander Hamilton Institute

Caustic Soda
- Pennsylvania Salt Mfg. Co.

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- Crossley Machine Co.
- Manufacturers Equipment Co.
- Mueller Machine Co., Inc.
- Philadelphia Drying Machinery Co.
- Proctor and Schwartz, Inc.

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- Harshaw, Fuller and Goodwin Co.
- Paper Makers Importing Co., (Inc.)
- Roessler and Hasslacher Chemical Co.
- Vitro Mfg. Co.

Clay (Abrasives)
- Old Hickory Clay & Talc Co.

Clay (Ball)
- Johnson Porter Clay Co.
- Old Hickory Clay & Talc Co.
- Potters Supply Co., The

Clay (China)
- Edgar Brothers Co.
- Drakenfeld and Co., B. F.
- Old Hickory Clay & Talc Co.
- Paper Makers Importing Co., (Inc.)
- Roessler & Hasslacher Chemical Co.

Clay (Electrical —Porcelain)
- Edgar Brothers Co.
- Johnson Porter Clay Co.
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- Paper Makers Importing Co., (Inc.)

Clay (Enamel)
- Edgar Brothers Co.
- Johnson-Porter Clay Co.
- Old Hickory Clay & Talc Co.

Clay (Fire)
- Edgar Brothers Co.
- Old Hickory Clay & Talc Co.
- Paper Makers Importing Co., (Inc.)

Clay (Potters)
- Johnson-Porter Clay Co.
- Old Hickory Clay & Talc Co.

Clay (Sagger)
- Edgar Brothers Co.
- Johnson Porter Clay Co.
- Old Hickory Clay & Talc Co.
- Paper Makers Importing Co., (Inc.)
- Potters Supply Co., The

Clay Handling Machinery
- Crossley Machine Co.
- Hadfield-Penfield Steel Co.
- Manufacturers Equipment Co.
- Mueller Machine Co., Inc.

Clay Miners
- Edgar Brothers Co.
- Johnson Porter Clay Co.
- Old Hickory Clay & Talc Co.

Clay (Wall Tile)
- Old Hickory Clay & Talc Co.

Clay Washing Machinery
- Crossley Machine Co.
- Mueller Machine Co., Inc.

Clay Working Machinery
- Crossley Machine Co.
- Hadfield-Penfield Steel Co.
- Manufacturers Equipment Co.
- Mueller Machine Co., Inc.

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- Seaboard Fuel Corp.

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- Harshaw, Fuller and Goodwin Co.
- Roessler and Hasslacher Chemical Co.
- Vitro Mfg. Co.

Conditioning Machinery
- Philadelphia Drying Machinery Co.

Conical Mills
- Hardinge Co.

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- Hadfield-Penfield Steel Co.
- Philadelphia Drying Machinery Co.
- Manufacturers Equipment Co.
- Mueller Machine Co., Inc.

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- Charles Engelhard, Inc.

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- Crossley Machine Co.
- Hadfield-Penfield Steel Co.
- Hardinge Co.
- Manufacturers Equipment Co.
- Mueller Machine Co., Inc.

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- Harshaw, Fuller and Goodwin Co.
- Roessler and Hasslacher Chemical Co.
- Vitro Mfg. Co.

Disintegrators
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- Crossley Machine Co.
- Hadfield-Penfield Steel Co.
- Manufacturers Equipment Co.
- Mueller Machine Co., Inc.

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- Manufacturers Equipment Co.

Dryers (China Ware—Porcelain)
- Philadelphia Drying Machinery Co.
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- Russell Engineering Co.

Dryers (Radiated Heat)
- Manufacturers Equipment Co.

Drying Machinery
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- Crossley Machine Co.
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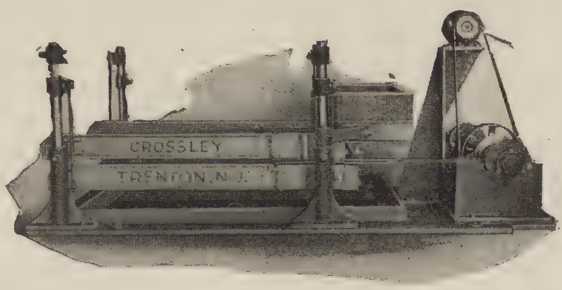

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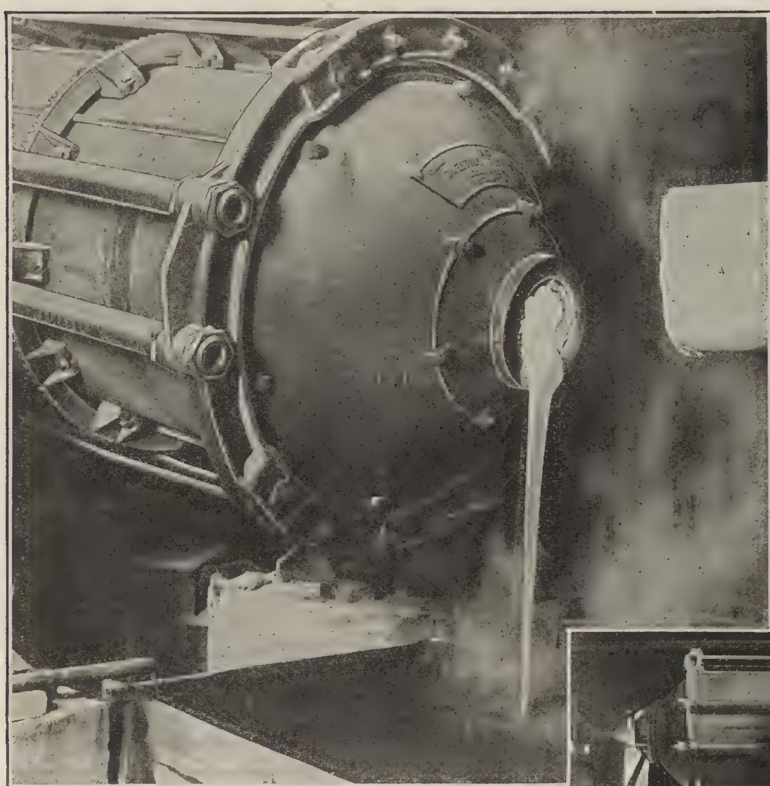

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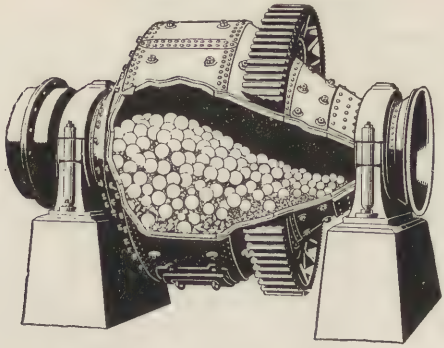

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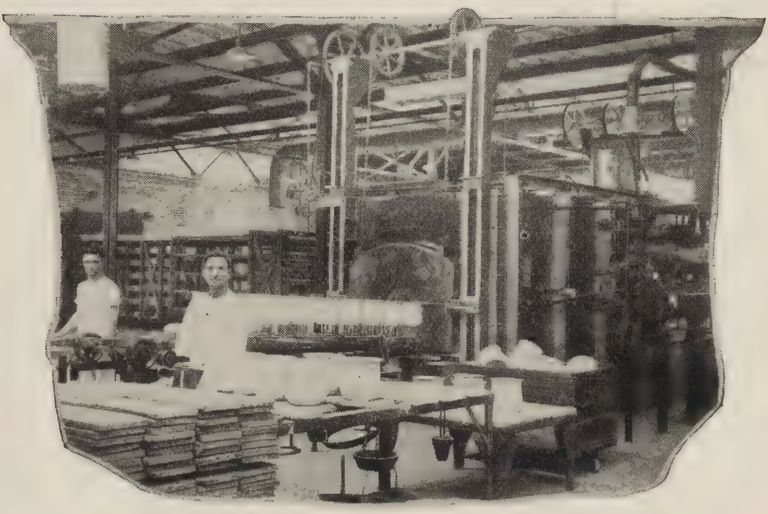

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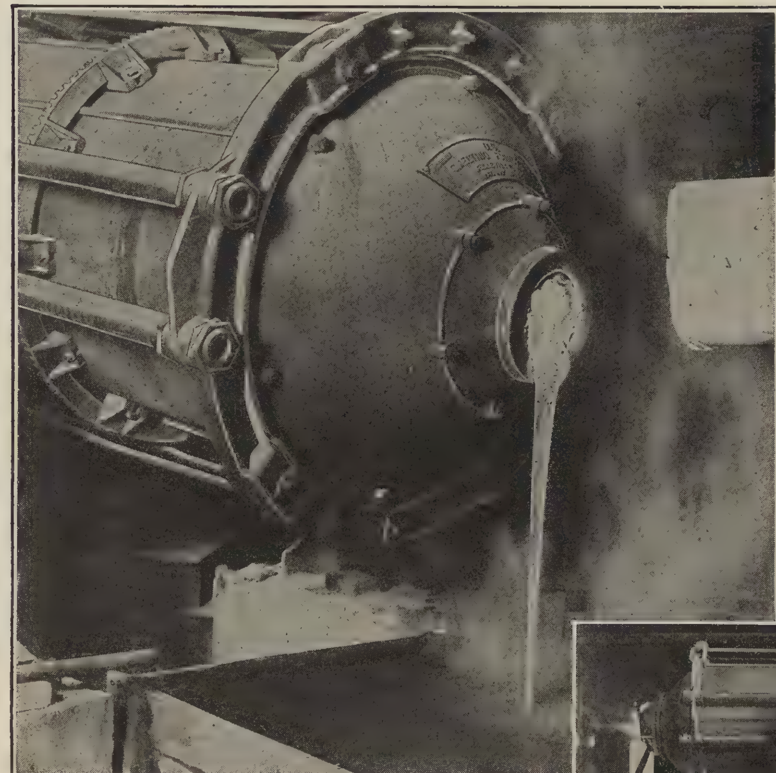

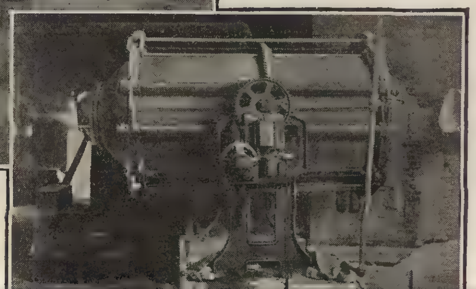

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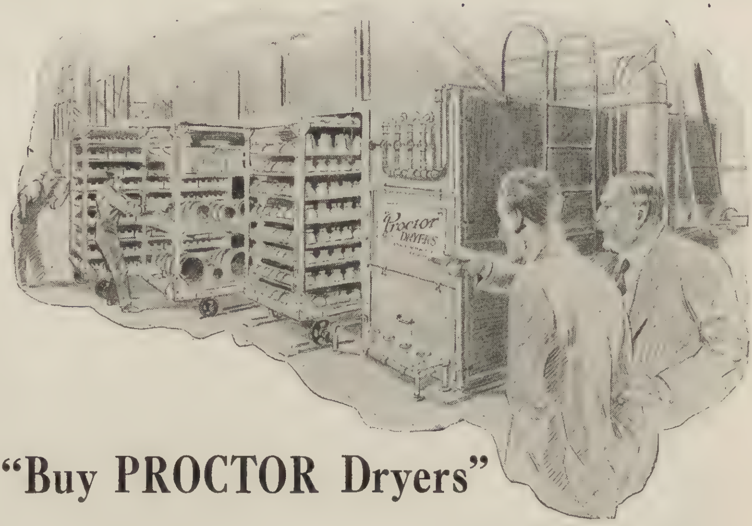

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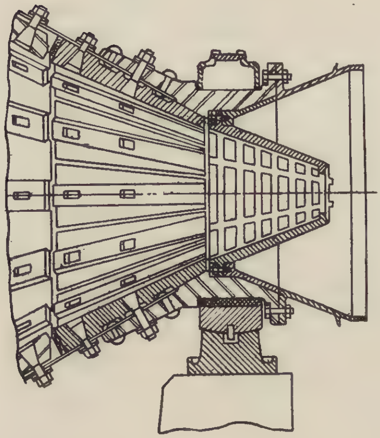

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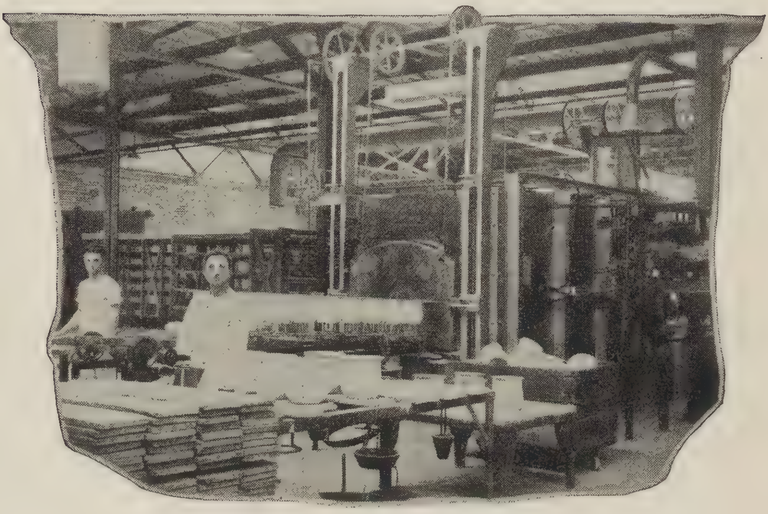

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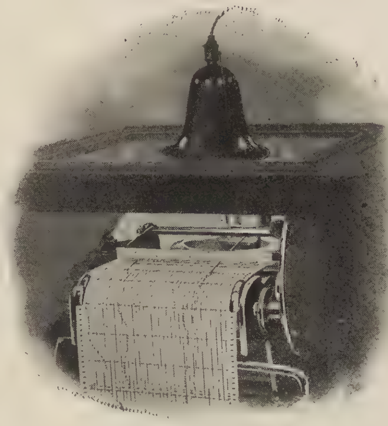

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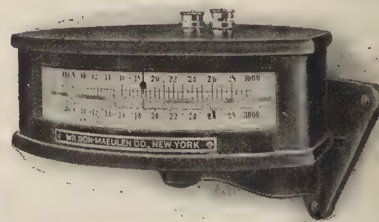

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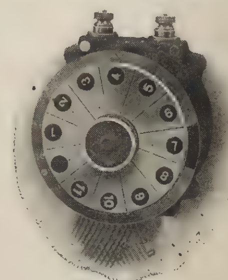

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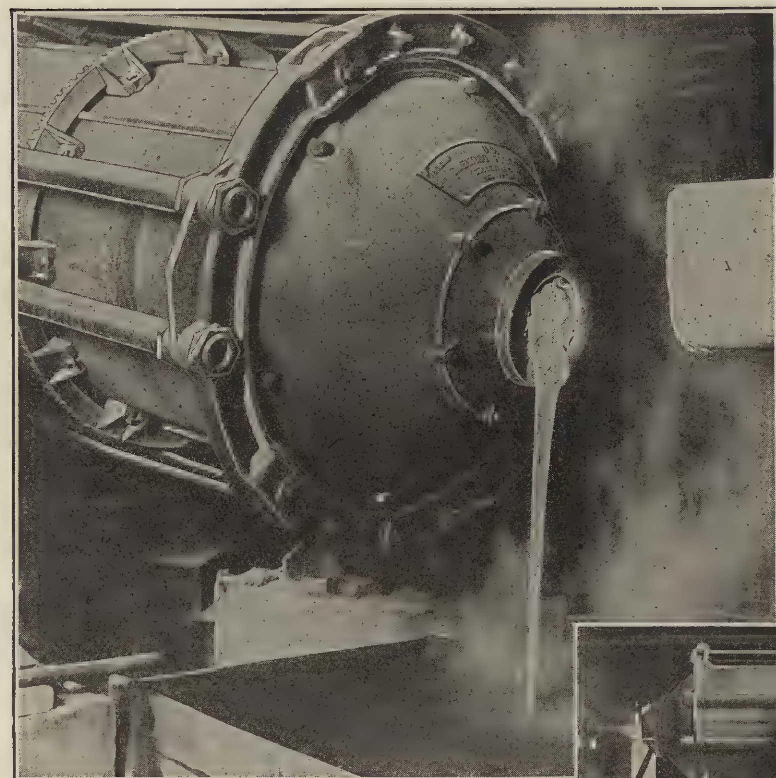

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These illustrations made from photographs taken in the plant of Ingram-Richardson Mfg. Co., Beaver Falls, Pa.

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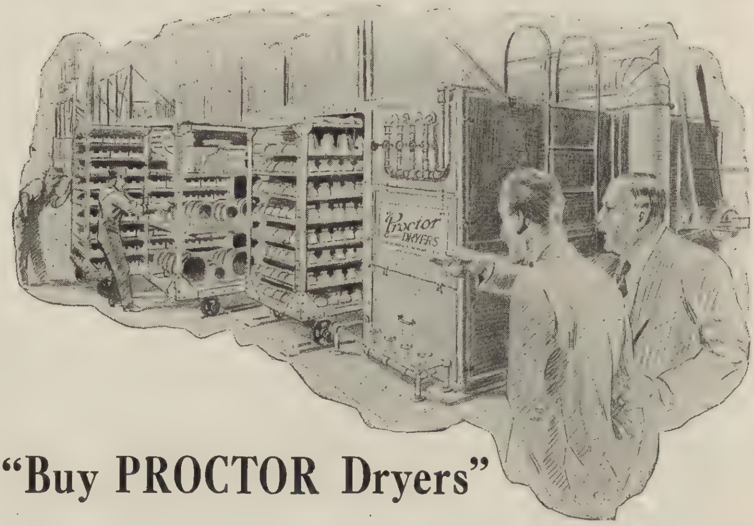

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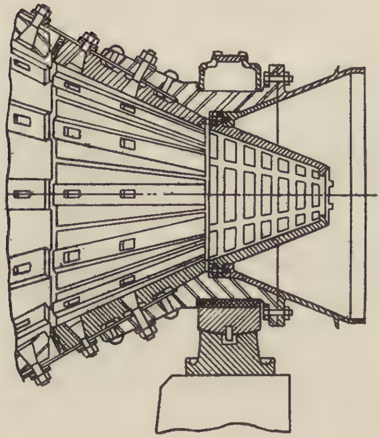

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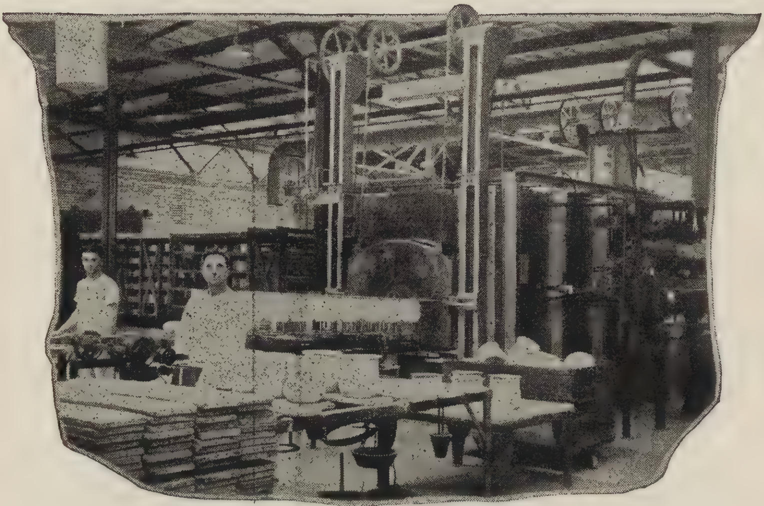

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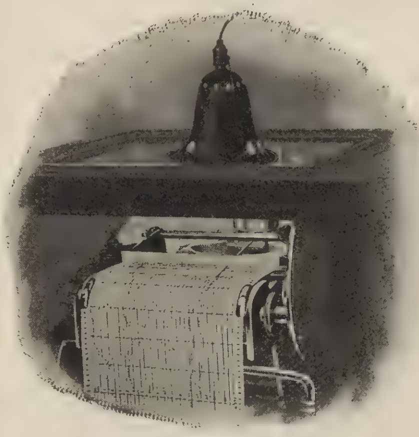

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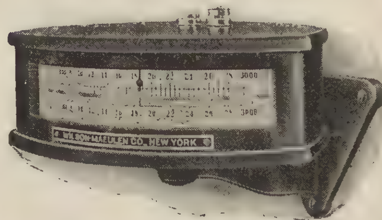

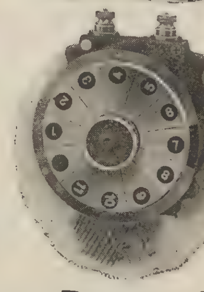

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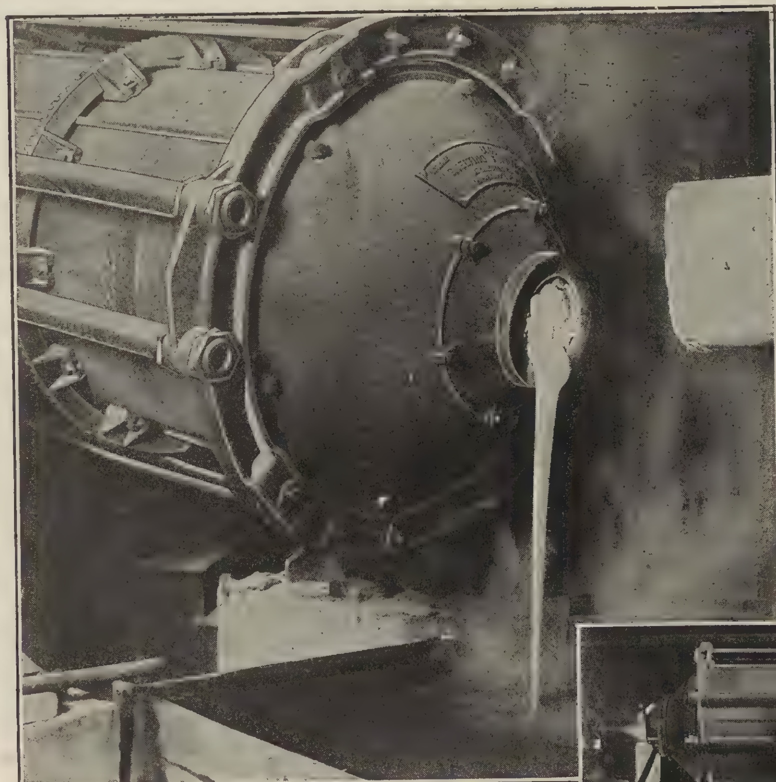

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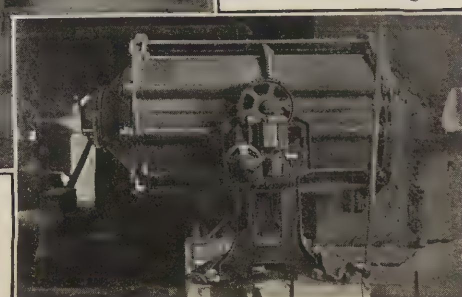

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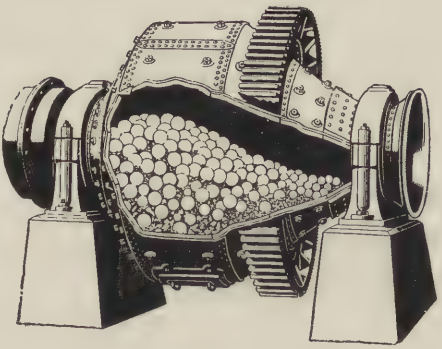

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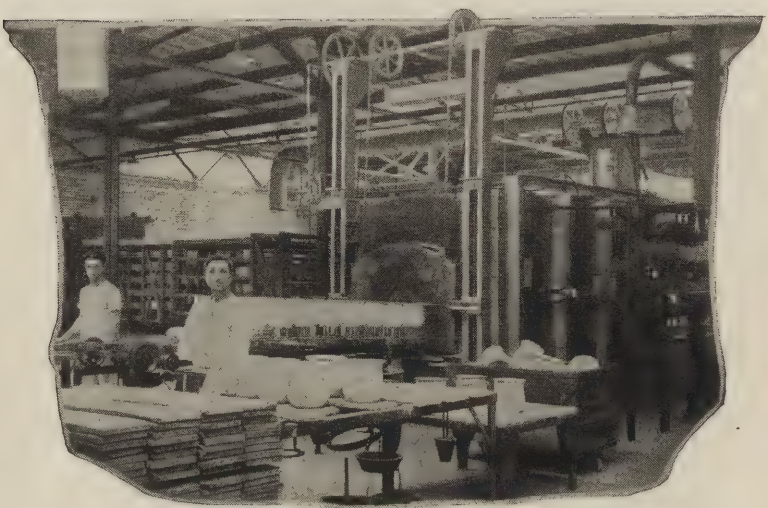

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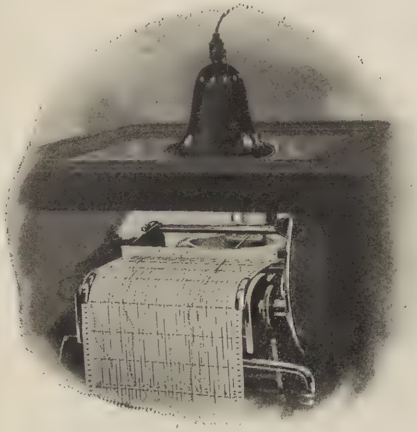

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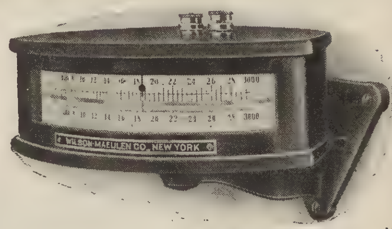

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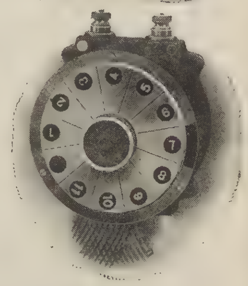

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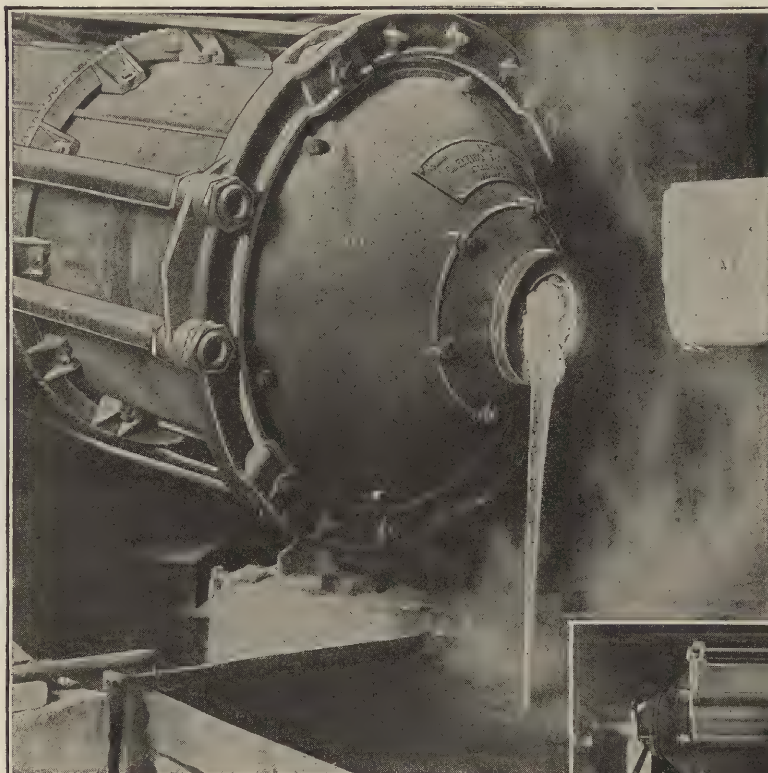

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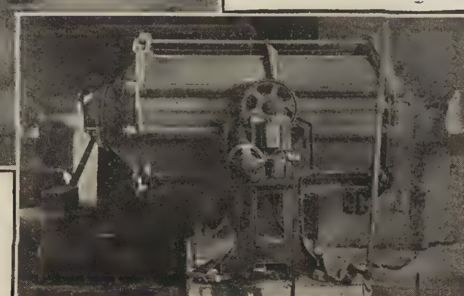

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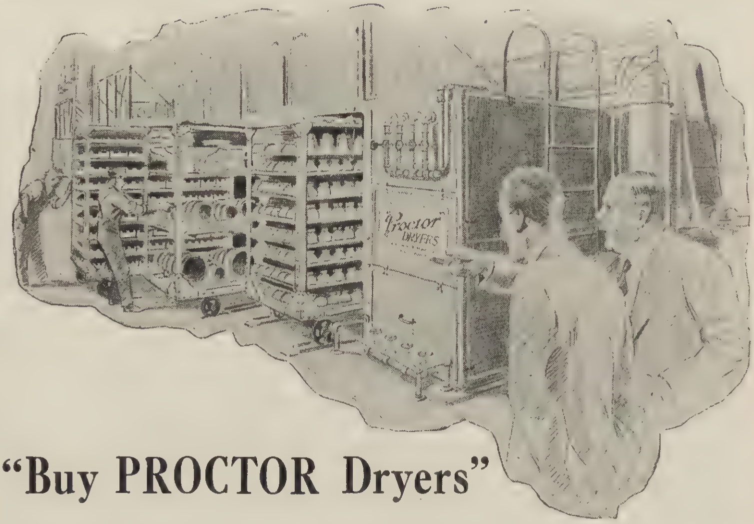

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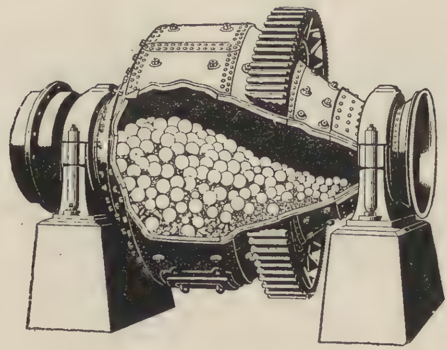

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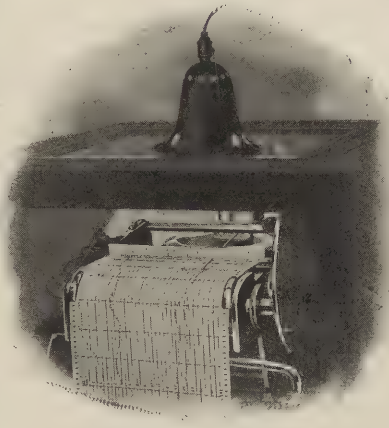

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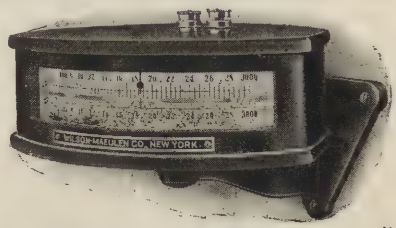

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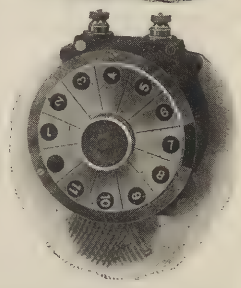

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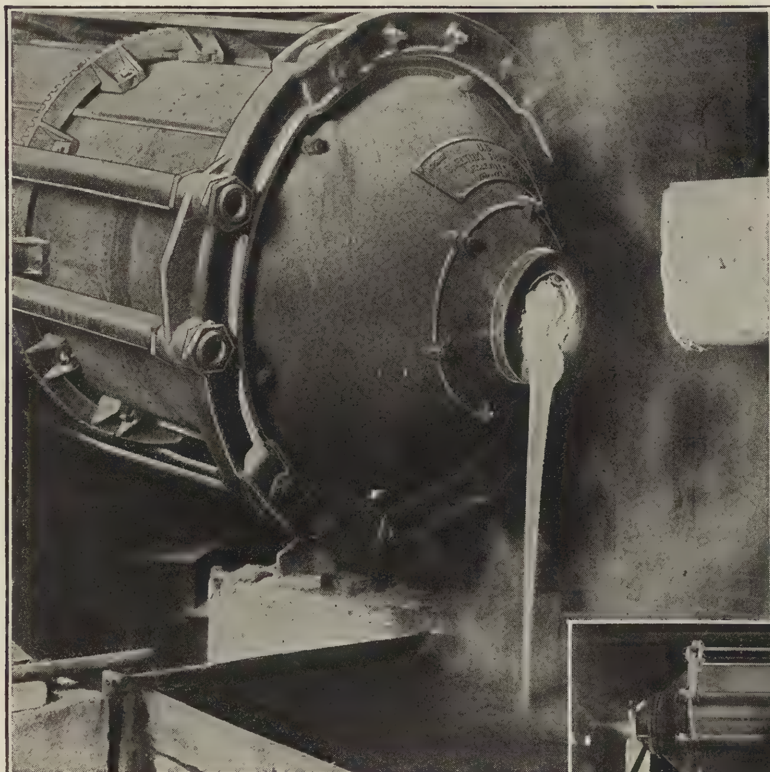

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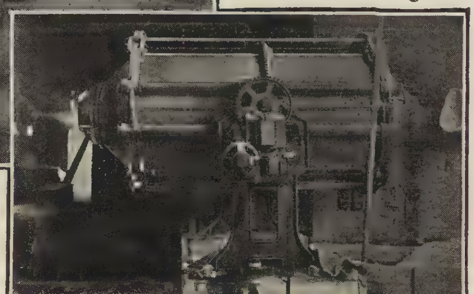

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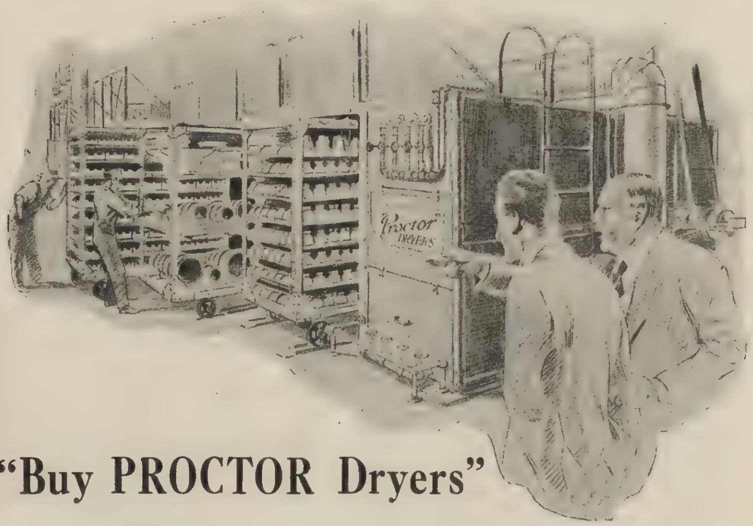

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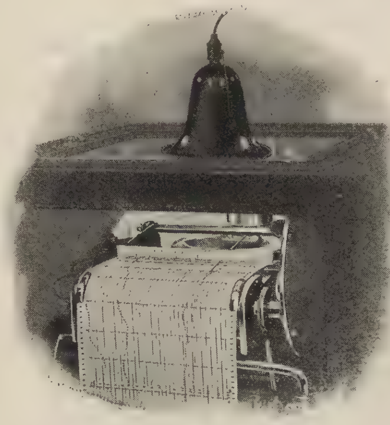

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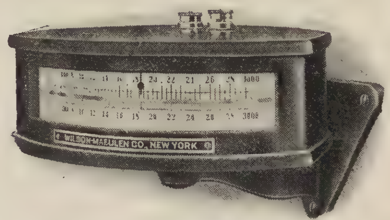

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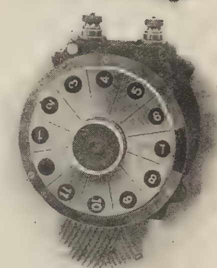

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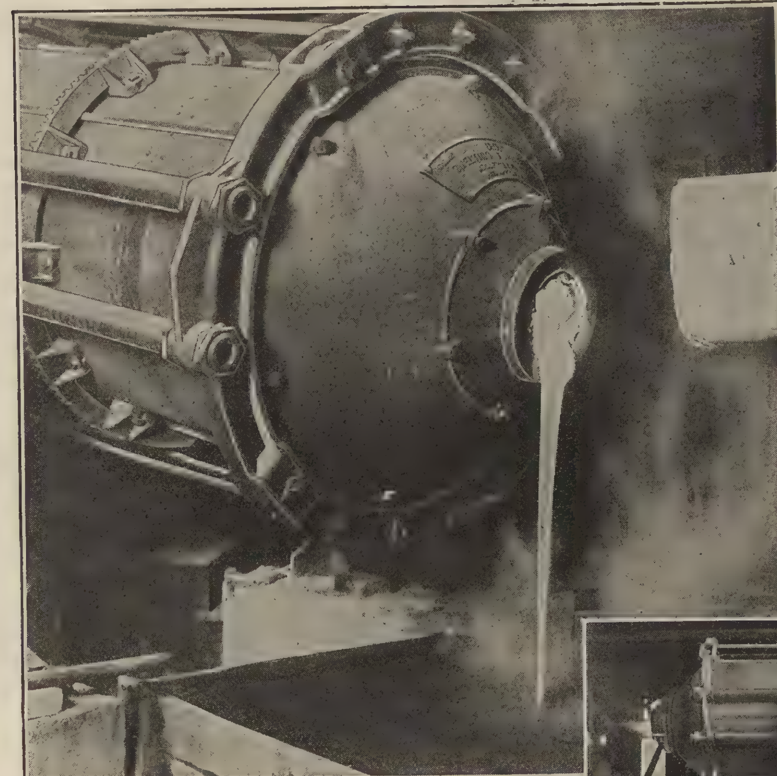

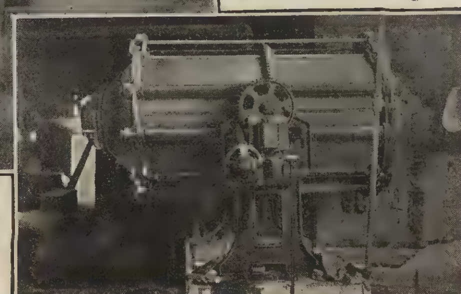

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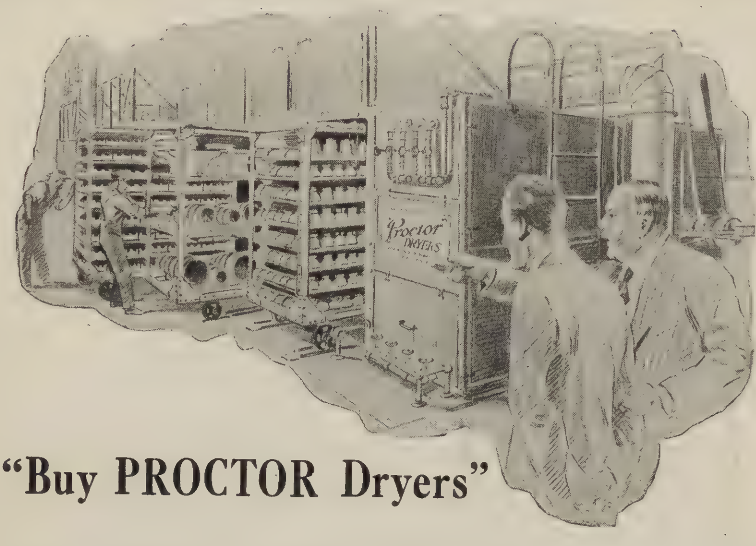

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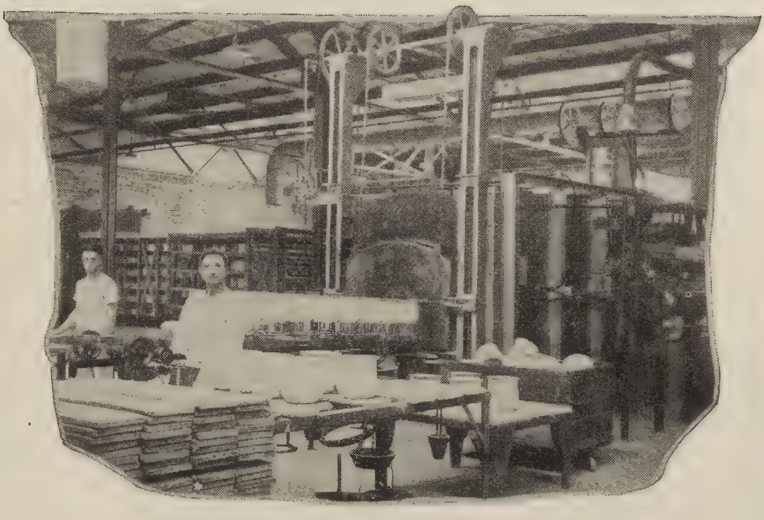

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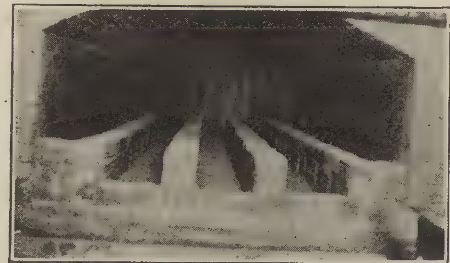

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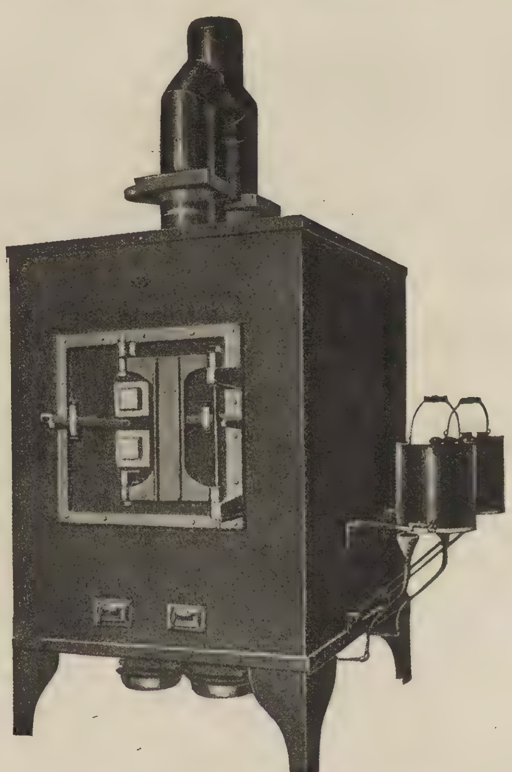

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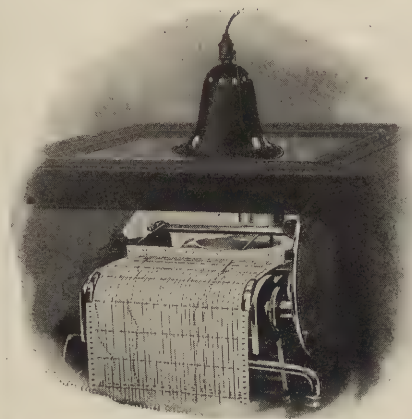

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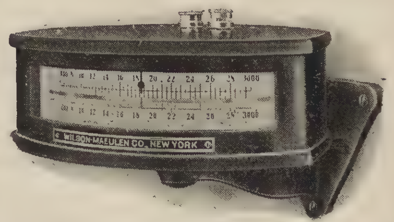

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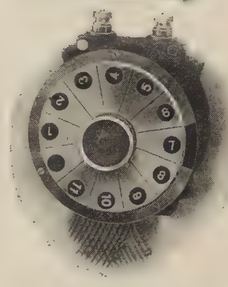

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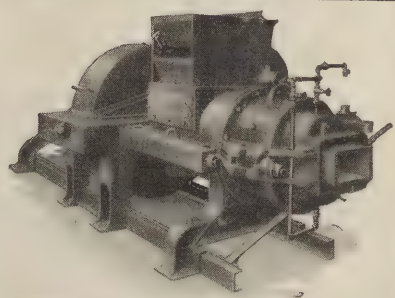

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